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Brass Firm Makes Malleables

Desire To Exercise Complete Control Over the Manufacture of all the Castings Incorporated in Its Commercial Product Induced the Company To Erect Its Own Malleable Iron Foundry

BY PAT DWYER

SPECIALIZING in electrical equipment for traction systems, the Ohio Brass Co., Mansfield, O. for many years has maintained a nonferrous foundry and immense manufacturing plant in that city. It also operates an independent but supplementary factory in Barberton, O., for the manufacture of porcelain insulators. The practice formerly was to buy all the malleable iron and steel castings required and assemble them in the Mansfield plant. The castings were secured from several outside interests, at various times, depending upon the usual business factors, price and time of delivery. Naturally the product from different plants showed a certain amount of variation from time to time, and this item was one of the deciding factors in influencing the as-

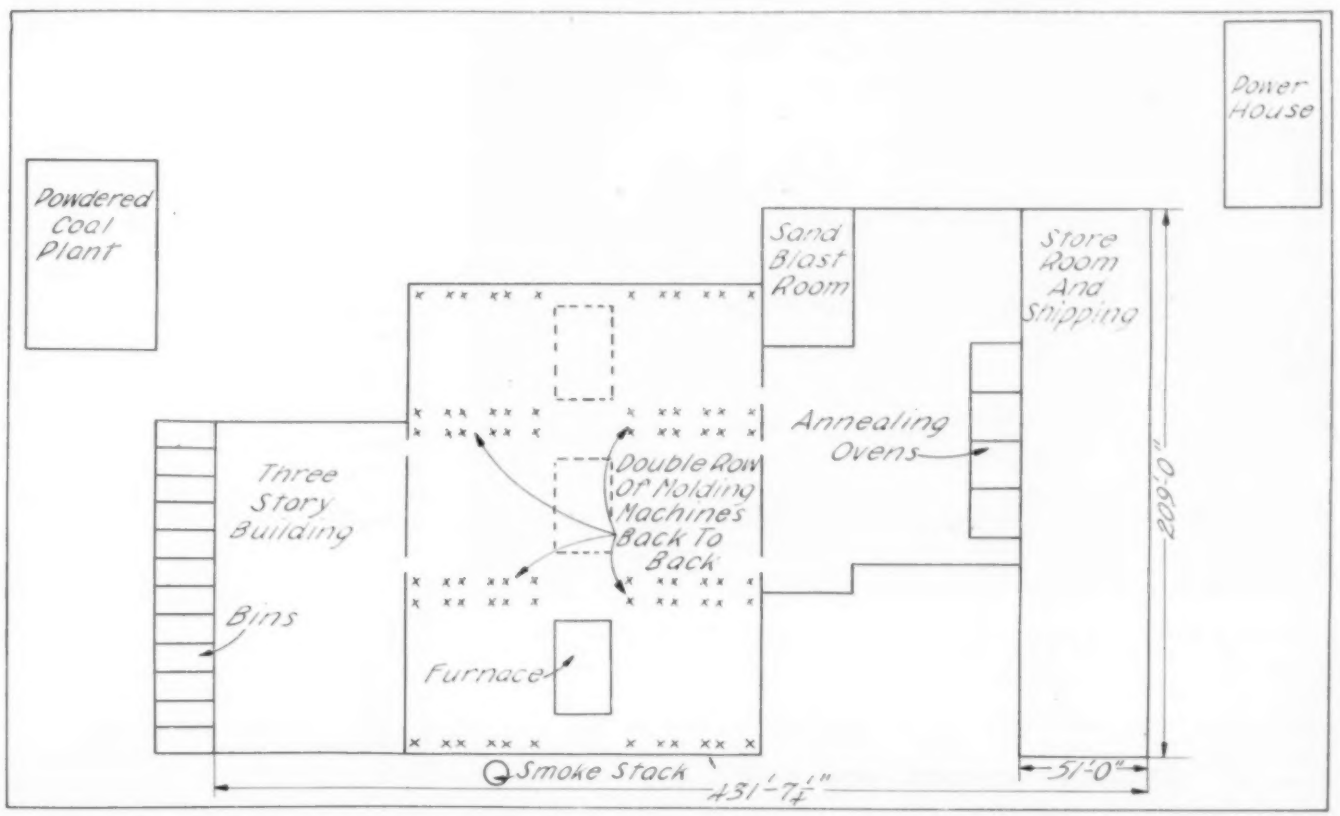


FIG. 1—GENERAL LAYOUT OF FOUNDRY INDICATING HOW ANY OR ALL OF THE VARIOUS DEPARTMENTS MAY BE EXTENDED LATERALLY WITHOUT INTERFERING WITH THE SEQUENCE OF OPERATIONS, COMMENCING AT THE SAND BINS AND ENDING AT THE SHIPPING ROOM

sembling company to establish its own malleable-iron foundry. A sufficient tonnage of its own castings was assured to make the venture feasible, and the prospect of securing an equivalent amount of outside work promised to make it not only a manufacturing convenience but a commercial success. An extensive survey covering many of the principal malleable casting plants in the country was conducted before the plans for the present building were approved and actual construction commenced. Of the many outstanding features connected with the new plant one is the installation of powdered coal equipment to serve melting furnaces, annealing ovens and core ovens. A second is the general design of the group of buildings whereby any or all of the units may be extended laterally should conditions render such expansion advisable.

The new foundry covering 100,000 square feet of floor space is located on part of the company's extensive 40-acre property at some little distance back from the many buildings comprising the remainder of the plants. Tracks of the Baltimore & Ohio and the Erie railroads separate the property into two parts, but a cement roadway 20 feet wide

FIG. 2—MOLDING, CORE AND SAND-BLAST SANDS ARE DISCHARGED DIRECTLY FROM THE CARS INTO 12 UNDERGROUND BINS, EACH HAVING A CAPACITY OF THREE CAR LOADS

tunneled under the tracks eliminates any traffic delays, and furnishes a ready means of communication between the malleable foundry and the older part of the plant.

Desire on the part of the management to further promote the harmonious relations hitherto prevailing in the plant has led to the installation of hygienic and safety devices and the adoption of the most advanced ideas along these lines. As an example a vacuum cleaning system is used to keep the coal building free from dust and dirt. Practically everything which is feasible has been done to make the foundry a desirable place in which to work. Elevators, cranes, trucks and rollers eliminate much of the heavy manual lifting. Smoke and dust are taken care of by the design of the building and by an exhaust system which removes all the dust from grinding stands and sand-blast cabinets. Lighting, wherever possible, is from the

FIG. 3—INTERIOR OF PULVERIZED FUEL PLANT SHOWING COAL DRYER, STORAGE HOPPERS AND BLOWING TANK

north. Several heating units made by Skinner Bros. Mfg. Co., St. Louis, in which air is drawn through a series of steam coils, are employed for heating the different departments in the main foundry. The wash rooms, girls rest room and other detached sections are heated by steam circulated directly in coils attached to the walls or in other suitable places. The walls of the building are made of red brick and the steel-frame roof is covered with gypsum tile which, as a nonconductor of heat, tend to keep the building cool in summer and warm in winter.

Wash and locker rooms are provided for both men and women employes. The men's room is shown in Fig. 8. In addition to the white enamel wash basins equipped with special spray nozzles designed and manufactured by the company, a row of shower bath booths extend all along one side to the left in the illustration. The beginning of a row of clothes lockers may be seen to the right of the same illustration. One of the personal touches characteristic of

the company's policy attaches to these lockers. Before placing the order the general superintendent, L. W. Olson, hung his overcoat in a locker submitted for a sample and finding that it did not clear the floor specified that all lockers orders by the company should be 6 inches higher than the regular stock size. He felt that a feature objectionable to him would be equally objectionable to the men regularly using the lockers.

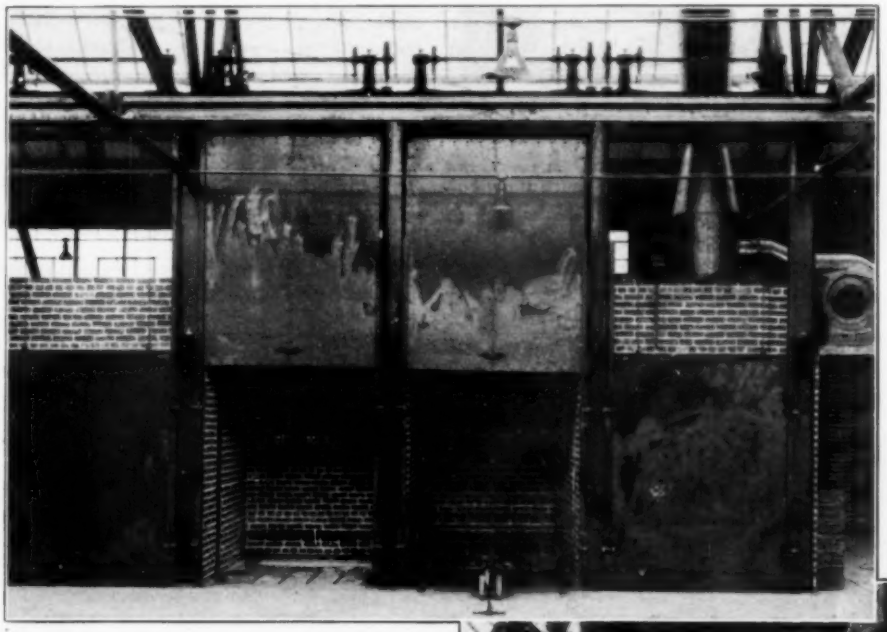


FIG. 4—THE CORE OVENS ARE HEATED FROM ONE FIRING CHAMBER LOCATED ON THE FLOOR BELOW

The girls' wash and locker room is located on the floor immediately above the men's wash room. In addition to the usual facilities, one part in charge of a matron, is partitioned off and fitted up as a rest room. It is on the same floor as the coremaking department which, with the exception of one or two men who attend the ovens and distribute the sand, is *manned* altogether by female help. After a brief discussion of powdered coal in its application to malleable-iron foundry use, the different departments of the foundry are touched upon in more detail.

The theoretical advantages of pulverized fuel have been recognized for a number of years, but not until improvements were made in the methods of pulverizing transporting, storing and burning was the process rendered commercially practical. Pulverized fuel properly applied combines the economic features of coal with the quick control of oil and gas and in addition provides a characteristic flame particularly advantageous in many processes. If it were simply a matter of pulverizing the fuel by any method and then blowing it into the furnace, pulverized fuel would have advanced more rapidly as a heat producing medium. Methods of using this form of fuel to advantage have taken years to develop on account of many unforseen factors cropping up and materially altering the original conception. Coal now can be pulverized, transported and burned with equipment requiring labor of only average skill to keep it in efficient running condition. Also the entire plant can be kept clean when using powdered coal.

FIG. 5—THE CORE ROOM, WELL LIGHTED AND VENTILATED, IS SITUATED ON THE TOP FLOOR OF THE BUILDING SHOWN AT THE LEFT OF THE GROUP IN FIG. 1

Among the claims set forth by the manufacturers of powdered coal equipment and substantiated by users to a sufficient degree to influence the Ohio Brass company in its selection of that type of equipment, are cleanliness and convenience, and what perhaps is more important economy in operation cost.

Easy on Brick Work

It is stated that by applying the burners to the melting furnace in such a manner that the flame is directed downward toward the bottom of the charge and on the bath after the charge has melted, the usual top blast may be eliminated, thus preventing excessive oxidation of the metal and unnecessary burning of the brick work. The only necessity for having a top blast on a furnace is to carry the flame downward on to the bath which moves the slag and top iron toward the back of the furnace and sets up a circulating motion. Powdered coal burners set at a proper angle produce the same result without the aid of top blast and this feature partly accounts for the long life of the brick work on the furnace and a low pig iron requirement in the charge. Further, on account of the absence of special bungs the roof is easier to keep in repair.

Additional interesting statistics compiled by one manufacturer indicate that on the average hand-fired furnace, approximately 19 bricks are used per ton of iron melted, while with powdered coal as a melting medium, only 9 bricks are used per ton of iron melted. The walls of a powdered coal-fired furnace burn down evenly and the slag line does not burn in as bad as on a hand-fired furnace. From 2 to 4 hours are saved per day on the firing time, depending on the size of the furnace. One man can fire and skim the furnace with part time help from a second man to take care of the slag as it is skimmed off. The fuel consumption ratio is betwen 3 and 4 to 1, depending on the size of the heats, quality of coal used and size of furnace. Substantial savings in fuel, labor and pot costs are claimed for annealing ovens in which powdered coal is employed for fuel. More space than usual above the pots in an annealing oven, is desirable because the gases are much more expanded at this point and the oven can be forced harder without danger of burning the pots or arch if the latter is constructed properly.

The general layout of the new malleable iron plant is shown in Fig. 1.

Commencing at the end shown at the left and taking the different units in turn, it may be noted that manufacturing operations begin at one end and move steadily to the shipping room at the opposite end of the building. The powdered coal plant is located in a separate building outside the north end of the foundry as shown in Figs. 1 and 2, and the power house occupies a somewhat similar position at the south end. Probably the most acceptable method to describe the plant would be to commence at one end and take up each department more or less in detail.

The coal entering the building shown to the extreme left of the illustration Fig. 1, is handled mechanically many times before it is discharged through the small steel pipe shown near the top of the illustration leading from the coal building to the foundry. It is taken by bucket elevator from a hopper in the track to an elevator storage tank and then on a belt conveyor to a dryer Fuel as it comes to the plant contains from 5 to 30 per cent moisture and if pulverized in that condition would pack in the bins, reduce the capacity of the pulverizer mill, interfere with the uniform feed of the controller, retard the action of separation with other screens or air separators and lower the flame temperature. The belt conveyor is provided with a magnetic pulley which removes any pieces of iron or steel that inadvertently may have been concealed in the coal. The pulley is magnetized by passing direct current through the windings located within, thereby causing the magnetic flux passing through the belt to attract any iron or steel in the coal and hold it in contact with the belt past the ordinary overflow or discharge point. The metal is dropped into a hopper or chute when the magnetic attraction has diminished due to the increase in distance as the belt leaves the pulley.

Travels under Pressure

From the dryer the coal is discharged into a pulverizer which reduces it to a powder. When a 1-inch cube of coal is pulverized so that 95 per cent will pass through a 100-mesh screen, over 200,000,000 particles are produced and the exposed area is increased 700 times. On this basis it was thought that the finer the fuel was pulverized the more efficient would be the burning. While theoretically this may be true other conditions arise in the process of burning which seems to indicate that extremely fine pulverizing is a waste of energy. It has been found that bituminous coal need not be pulverized finer than a point where 90 to 95 per cent will pass through a 100-mesh screen and 70 to 75 per cent through a 200-mesh screen. Anthracite coal or coke is fine enough when 85 per cent will pass through a 200-mesh screen.

The coal in the pulverized-fuel bin flows by gravity into a tank provided with a dust-tight gate and an air inlet. When the desired quantity of coal is in the tank, compressed air is admitted and after the pressure has reached a certain predetermined point the valve is opened in the transport line and the coal starts on its way to the various points in the foundry where it is used. The system was designed and installed by the Ground Coal Engineering Co., Chicago.

Molding and core sand arrive on a siding and are discharged into underground bins through a series of 12 center and side hatches shown in Fig. 2. Each of the 12 bins, 35 feet long, has a holding capacity of 3 carloads, or a total storage capacity of 36 carloads of sand. The sand bins open into the basement of a 2-story building provided with all the necessary equipment for preparing and mixing the core sand including a 4-foot pan made by the National Engineering Co., Chicago and an oil-fired revolving drum in which all the core sand is dried before it is mixed in different proportions for the coremakers' use.

An oil binder is used throughout, but several varieties of sand are incorporated in the different mixtures employed. The company maintains a large engineering and research staff and the subject of core-sand mixtures is one that has received a considerable amount of attention. Among other features tending toward economy of operation it has found that the entire amount of spent silica sand collected in the sand-blast dust arresters can be utilized as core sand. The amount used in each batch varies according to the relative position the resulting cores will assume in the castings. The fine dust closes the pores and cannot be used to any great extent in cores almost entirely surrounded by metal and where the quick and free egress of the generated gas is of paramount importance, but in other places where these conditions do not obtain, a generous

FIG. 6—THE FLAME FROM THE POWDERED FUEL BURNER IS DEFLECTED DOWNWARD THROUGH AN OPENING IN ONE END OF THE FURNACE AND THUS ELIMINATES THE NECESSITY OF PROVIDING A TOP BLAST

amount of the dust produces a fine surface on the castings.

Core sand from the mixer and molding sand from the bins is loaded in wooden boxes to be picked up by electric truck and taken to a elevator serving the foundry, at the ground level, and the core room, one story above. The core room, partly shown in Fig. 5, is equipped with double rows of benches, back to back, set at right angles to an almost continuous window extending from within a few feet of the floor to the ceiling. Additional light and ample ventilation is provided by the style of roof and swinging sash on both sides. A smooth concrete floor facilitates the use of a lift truck employed to transport the loaded core racks to and from the ovens. In addition to the benches on which the girls make the cores by hand two pneumatic machines supplied by Wm. Demmler & Bro., Kewanee, Ill., are employed at the opposite end of the core room in making a great many of the cores. With these machines the sand is blown into the corebox under pressure, thus rendering it possible to make many cores as units which otherwise would have to be made in split boxes and pasted.

Heating the Core Ovens

The battery of four core ovens installed by Holcroft & Co., Detroit, is shown to the left of Fig. 5 and more in detail in Fig. 4. Provision is made at one end of the battery to erect an additional battery of four similar ovens when conditions warrant. The battery is heated from a common flue extending under the floor from end to end. One end of the flue receives the heat from the firing chamber and the other end discharges into the chimney. Suitable dampers are provided in each oven so that they may be controlled individually. Induced draft is provided by a fan located nearly on a level with the oven roof at one end of the battery. It is employed to remove the gas and steam generated during the initial stages of the baking process and is shut off when this stage has been passed. The powdered coal apparatus used in connection with the ovens is located in that part of the building immediately below the ovens. It comprises a hopper, a feed pipe, a burner and a small blower which supplies the air for combustion. The hopper is suspended from the ceiling but the motor, fan and controlling apparatus is mounted on a stand on the floor, inside a wire guard and within easy reach of the operator who attends to firing the ovens as part of his regular duties.

The remainder of the ground floor back of the firing apparatus is fitted up for, and used as, a core assembly and storage department. The cores are brought down from the upper story after they have dried. On the lower floor they are checked, fitted and loaded in trays for distribution to the different floors in the foundry. The 3-story building containing the storage basement, the core department, and the locker and wash rooms measures 80 x 120 feet.

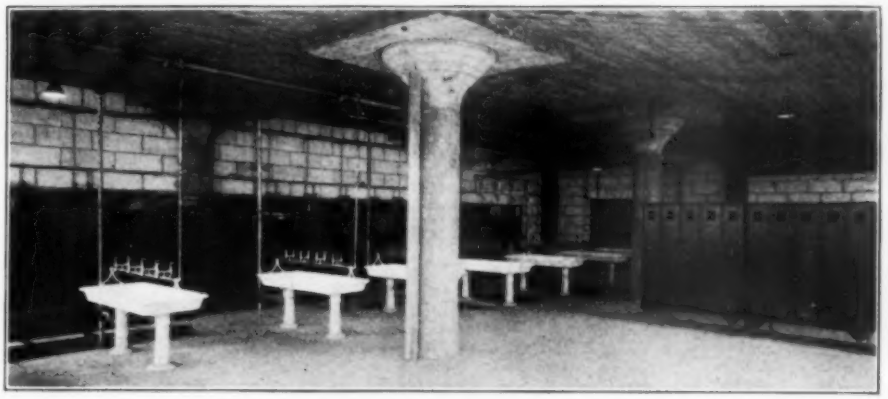


FIG. 8—THE WASH ROOM IS PROVIDED WITH A FULL EQUIPMENT OF ENAMEL WASH BASINS, SHOWER BATHS AND CLOTHES LOCKERS

Molding Floor Layout

The general plan of the foundry floor is shown in Fig. 1 and a detail of the molding floor layout is shown in Fig. 7. Four groups of molding machines, twelve in a group, are arranged in pairs, back to back, as shown in Fig. 7. Four single groups six in a group are arranged across each end. Grouped in this manner two operators work from a single sand heap. With the exception of a few hand squeeze machines, all the molding machines are similar to those shown in Fig. 7, a type of power squeezer recently developed by the Federal Malleable Co., West Allis, Wis.

The foundry building is divided by two rows of columns into three bays. The molding floors occupy the two side bays while the center bay is devoted to the melting equipment. One 20-ton furnace is already in operation and preliminary work is completed on the space reserved for two more, the location of which is indicated by dotted lines in Fig. 1. The furnace is equipped with spouts on both sides to serve either molding bay. The roof center bay is considerably higher than the others to provide a runway for a 5-ton Milwaukee crane employed for charging the furnace, shifting bungs and other miscellaneous jobs of a like character. The charge is brought in from the yard on buggies, picked up by the crane and deposited on the furnace hearth through suitable openings in the roof made by setting the bungs temporarily to one side.

The powdered coal equipment and

FIG. 7—MOLDING MACHINES TO THE NUMBER OF 72 ARE ARRANGED IN FOUR DOUBLE GROUPS OF 12, AS SHOWN, AND FOUR SINGLE GROUPS OF SIX EACH ACROSS THE ENDS OF THE SHOP

FIG. 9—THREE TRANSFER ROLLER CARS ARE EMPLOYED IN TRANSPORTING THE CASTINGS TO THE VARIOUS MACHINES AND BENCHES IN THE CLEANING ROOM

the manner of its application to the melting furnace is shown in Fig. 6. The 4-inch supply pipe attached to the column in the near foreground passes under the floor for a short distance and then extends upward at the end of the furnace, entering the hopper shown supported on a frame work above the remainder of the burner equipment. This arrangement is necessary to provide a clear space for the operation of the crane. If it only was necessary to supply one furnace with fuel the supply pipe might have been led directly to the hopper, but since the one distribution system has been designed to serve fuel burning units in several parts of the plant, modifications like the foregoing have ben introduced at various points.

An underground flue designed to serve the present furnace and the two additional contemplated furnaces extends from one end of the building to the other and terminates at the west end in a large smokestack located outside the building. In the two molding bays the floors are covered with sand, with the exception of the area around the molding machines and two gangways extending across the shop from side to side and covered with concrete.

The sand-blast room shown in the upper left hand corner of the annealing room, Fig. 1, is partitioned off from the remainder of the cleaning department. It is equipped with four sand-blast units designed by the engineering department, and erected by the company's employes. A monorail branch extending over each sand-blast barrel supports a light, hand operated, electric hoist employed for lifting the metal containers holding the castings, and also for handling the door of the barrel. The four branches terminate in curved switches by which they are united to a straight length of monorail leading into the chipping and grinding department. Transfer cars as shown in the foreground, Fig. 9, are employed to distribute the castings to the various benches and grinding stands. The floor of the cleaning and annealing room is covered with wood blocks.

After the castings are cleaned and chipped they are packed in pots and placed in the four ovens shown in Fig. 10. A storage battery charging machine made by the R. & L. Baker Co., Cleveland is employed for the purpose and also for handling the doors which are made in halves. The general features of both oven and door construction are shown in Fig. 10. The powdered coal equipment and burners are located at the back of the ovens. A number of small openings in the side walls close to the floor, communicate with a flue between each pair of ovens served by a common smokestack. Provision is made for an additional battery of two similar ovens if occasion should arise for their use.

Annealing malleable iron castings with powdered coal as a fuel no longer is regarded as a novelty. It has been practiced to a greater extent than the comparatively recent application of the same form of fuel to melting the material. In addition to the saving in time and labor over the hand-fired practice it is claimed that there is a large saving effected in annealing box renewals.

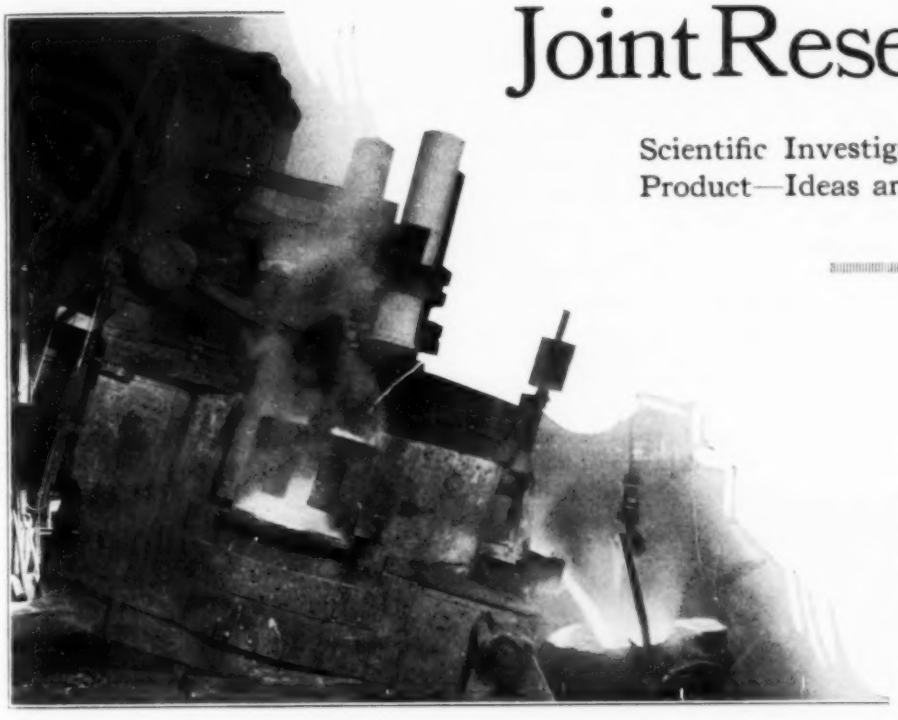
The cleaning room occupies a space 40 x 100 feet and the annealing room a somewhat larger space 100 x 120 feet. The annealing furnaces have a capacity of 15 tons each and castings can be raised to a temperature of 1500 to 1600 degrees Fahr. in 20 to 25 hours. They are maintained at this temperature for 60 hours and then allowed to cool slowly to room temperature after which they are removed to the adjoining warehouse department, 50 x 200 feet, where they are given a final grinding, and then are stored ready for shipment to the assembly department of the main plant.

Many of the castings have to be coated with zinc inside and out and this operation is performed in a department connected with the older group of buildings. Two processes are employed. In the first the article is dipped into a pot of melted zinc, quickly withdrawn, rubbed in a quantity of salamoniac, rinsed in water and set away to dry. In the second process, known as sherardizing, the articles are packed with a quantity of zinc dust in a steel cylinder and heated to a predetermined point in a furnace. A sufficient quantity of the zinc adheres to the surface of each casting to furnish a coating. Irrespective of which method is employed, the coated castings are piled out in the yard and exposed to the elements for several weeks for a weather test. At the end of the allotted time they are inspected for flaws in the coating. The perfect castings are passed and the others re-treated. The greatest care is necessary in cleaning the castings in the first place, otherwise the zinc coating will not adhere to the surface.

FIG. 10—IN ADDITION TO TRANSPORTING THE LOADED POTS TO AND FROM THE OVENS THE CHARGING CAR ALSO IS EMPLOYED FOR HANDLING THE DOORS

Steel Foundries Co-operate in Joint Research Work

Scientific Investigations Lead to Better Product—Ideas are Freely Interchanged



WITH improved quality as the goal and diligent teamwork as the means to that end group research has proved its worth to associated manufacturers producing a common product. No more trying conditions could be imagined for testing the worth of co-operative research than the depression which has marked almost the entire period of the association of five progressive steel casting manufacturers in the Electric Steel Founders' Research Group. While some large manufacturing interests possessed of practically unlimited means have cut their research appropriations to the bone, have lightened their overhead by reducing and even in certain cases dismissing entire research staffs, abandoning projects and sacrificing results of years of endeavor, this small body of steel casting producers has held steadily to its purpose, sustained by its faith in the ultimate outcome. Consequently, its members, the Electric Steel Co., Chicago, the Fort Pitt Steel Casting Co., McKeesport, Pa.; the Lebanon Steel Foundry, Lebanon, Pa.; the Michigan Steel Casting Co., Detroit; and the Sivyer Steel Casting Co., Milwaukee, emerge into the period of keen competition at hand well equipped in shop methods, quality of product, and organization morale.

This statement may seem exaggerated to those who are not familiar with the breadth and character of the work being done by this group. It will be difficult to understand without a knowledge of the accomplishments of the plan how, for example, the organization morale of the individual members could be appreciably benefitted. However, this assertion is fully supported by a familiarity with the facts which have been established.

This is the first of two articles presenting the aims, methods and working organization of the Electric Steel Founders' Research Group. The second will appear in the July 15, issue.

Take Castings Census

ASK any foundryman to tell you, off-hand, how many castings were made in his plant during one month and he probably would answer vaguely naming a few thousand. Of course, his conception of the total tonnage would be more accurate, but the number of pieces carrying the basic idea of the infinite detail required to produce the total output would be lacking in most instances. From records of the Electric Steel Founders' Research Group, it is found that in 1920, the total number of castings made was 2,569,327. This represents an average of 513,865 castings per year for each of the five members. The average of 370 tons per month produced by each plant does not indicate the scope of operations. The detail involved may be better appreciated by average figures covering one year's work, which show that 42,822 steel castings were produced per month by each member foundry.

The idea of group research and co-operative effort between five manufacturers making a similar class of steel castings had its inception early in 1920, when in response to a call by C. R. Messinger, of the Sivyer Steel Casting Co., a meeting was held in Pittsburgh, Feb. 25, 1920. Here a plan was outlined whereby technical problems could be solved by the combined efforts of the foundries associated.

Obviously, the basic requirements of an association of this character were implicit confidence between the members and the unselfish interchange of data. How well the idea has been carried out will be evident from the results attained. Improvement in quality of product, the underlying purpose informing the group, required the supervising control of a recognized expert in steel foundry practice. After some delay, the company secured the exclusive services of Maj. R. A. Bull, who had long been a dominant figure in the industry through his association with the Duquesne Steel Foundry Co., as vice president and general manager, and previously with the Chicago Steel Foundry Co., the Commonwealth Steel Co., and the American Steel Foundries. Major Bull's activity in the American Foundrymen's association, of which he was president in 1915 and 1916, had further fitted him for the task of organizing and correlating the staffs of the various members of the group. The wisdom of his selection is attested by the ready response and hearty co-operation observed among the superintendents, foremen and workmen in their attitude toward the research director, as Major Bull is termed.

Recognizing, from the first, the dual nature of the problems to be encountered, a working organization within the group was formed. This had two controlling committees, the general committee, having the decision on questions of policy, finance, and cost; and the technical committee, dealing with operating problems.

At present these committees are made up as follows:

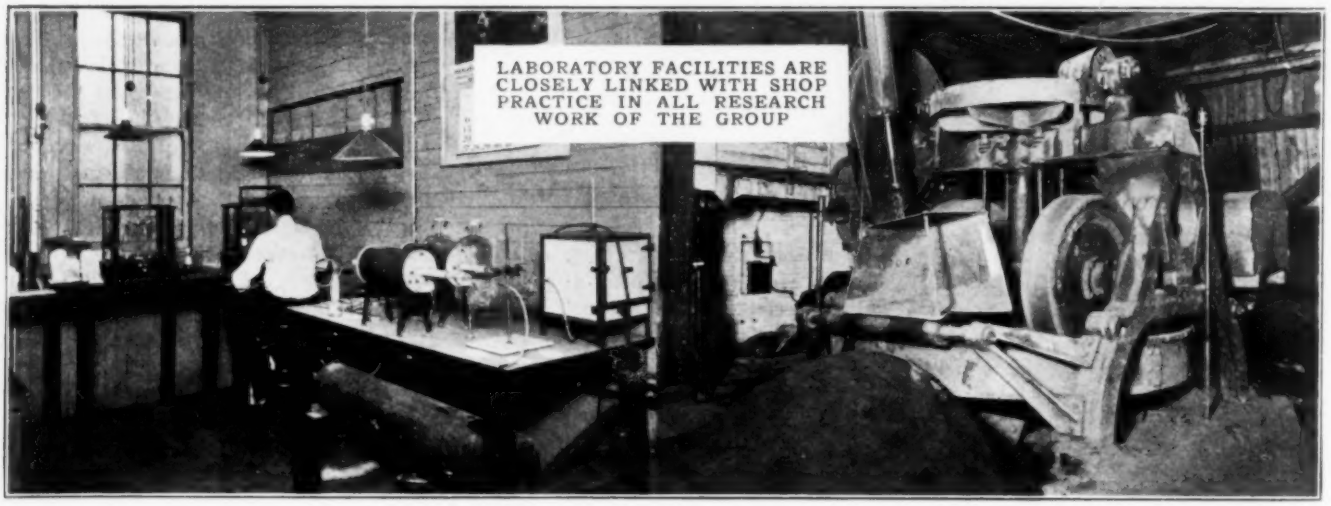
GENERAL COMMITTEE

Chairman, C. R. Messinger, vice president and general manager, Sivyer Steel Casting Co.
R. F. Flinterman, president, Michigan Steel Casting Co.
C. S. Koch, president, Fort Pitt Steel Casting Co.
John ... Olmsted, vice president and general manager, Electric Steel Co.
T. S. Quinn, treasurer, Lebanon Steel Foundry

TECHNICAL COMMITTEE

Chairman, William J. Nugent, vice president and works manager, Electric Steel Co.
R. J. Doty, vice president and works manager, Sivyer Steel Casting Co.
H. A. Neel, works manager, Michigan Steel Casting Co.
C. S. Koch, president, Fort Pitt Steel Casting Co.
T. S. Quinn, treasurer, Lebanon Steel Foundry

The question of selling prices for castings was banned from the start. Costs were considered only as an abstract problem; but the scientific study of costs to bring about more economical manufacture while maintaining and, when possible, improving quality, has been one of the most beneficial results of the association.



LABORATORY FACILITIES ARE CLOSELY LINKED WITH SHOP PRACTICE IN ALL RESEARCH WORK OF THE GROUP

As has been shown, the fundamental idea underlying the work of the group was the production of better quality steel castings. Reference to the process of castings made may help the reader to appreciate the comprehensive nature of the research work undertaken. All the companies comprising the group use the electric furnace as a melting medium. The average weight of castings produced by each ranges between 10.6 and 35.7 pounds, or an average for all the plants of 17.29 pounds as shown by the records for 1920. This average would be exceeded if the maximum weight which each plant is capable of handling were included. The castings are made for 148 principal industries which with 192 different branches or classifications make up 340 separate lines of manufacture served by the five companies. A few of the products of these industries are indicated in the following list: Automobiles and motor trucks; boats; brakes; bridges; hoist and grab buckets; blast furnaces; industrial furnaces; cranes; drilling machinery; ditching, excavating and paving machinery; elevators; electric power and control units; fire engines; machine tools; mine cars; printing presses; rolling mill machinery; tractors; tramways; tunnel machinery; and electric and steam railway equipment.

Only a few years ago, the full interchange of information between manufacturers engaged in the same line of endeavor would not have been remotely possible. Each individual formerly felt that the results of his investigations were his own property to be used solely for his own advantage. In consequence, overlapping efforts, confusion in applying results and many other evils incident to research conducted in a haphazard fashion are credited with many of the shortcomings of the steel casting industry during the period directly preceding the war. In forming the group for co-operative research, each member plant unreservedly pledged its organization to the work, freely offered the results of independent investigations, and laid all the cards upon the table in every case where information is sought. The interchange of information has been carried to the point of permitting foremen to work in the plants of other members assisting in the gathering and direct dissemination of data.

Holding the broad-minded conviction that information looking to the improvement of methods and processes should be disseminated with reasonable freedom to the industry at large by all who belong to it, the group proposes to make public the results obtained from certain investigations when they reach the stage where such publicity might benefit those outside the group who are interested in the problems attacked. Finding that research pays even in dull times, the group hopes to see the spirit of investigation extended in the industry. Having taken some time to develop a practical co-operative plan, the associated companies have given THE FOUNDRY free permission to explain the group scheme of operation for the possible benefit of other companies which may be considering systematic research into steel foundry problems.

The group's scheme of operation may be briefly indicated under five main heads. Broadly speaking, the results are obtained through the following means: Frequent meetings of group representatives; investigations authorized at these conferences and conducted at suitable plants; general inspections of each plant by the research director; transmission regularly of reports to and from the director; and the use of the director's office as a clearing house and distributing center for all technical information of value to the members.

The meetings are held frequently and usually last for three days. In most cases they are held where one of the member plants is located and each such plant is visited at a time when the greatest benefit may result from critical and thorough examination by all representatives of the accomplishments of the investigation at that time justifying joint consideration on the ground. These meetings are attended by the principal operating executives themselves and, as occasion may warrant, by some of their chief subordinates in close touch with the problems under consideration. Consequently, questions of operating expediency can be decided immediately through the authority vested by each company in its delegated representatives. The great advantage of this will be obvious.

A typical meeting is a scientific convention in miniature. The members to whom the group has delegated specific researches are required to present detailed written reports of these investigations showing the progress to date. These reports are mailed by the authors to each of the plants and to the director sufficiently in advance of each meeting to permit prior study by all conferees. The critical consideration given these progress reports is exhaustive, and leads to agreement as to the further steps for each investigation. These occasionally

require the participation of more than one plant in one research to test the application of a theory under different local conditions. Supplementing the reports by the members, the research director analyzes the status of the work and presents for consideration such additional problems for investigation as he feels profitably may be attacked next. Before adjournment, definite decision is reached on all matters the solution of which is possible, thus permitting the group to function with the utmost dispatch.

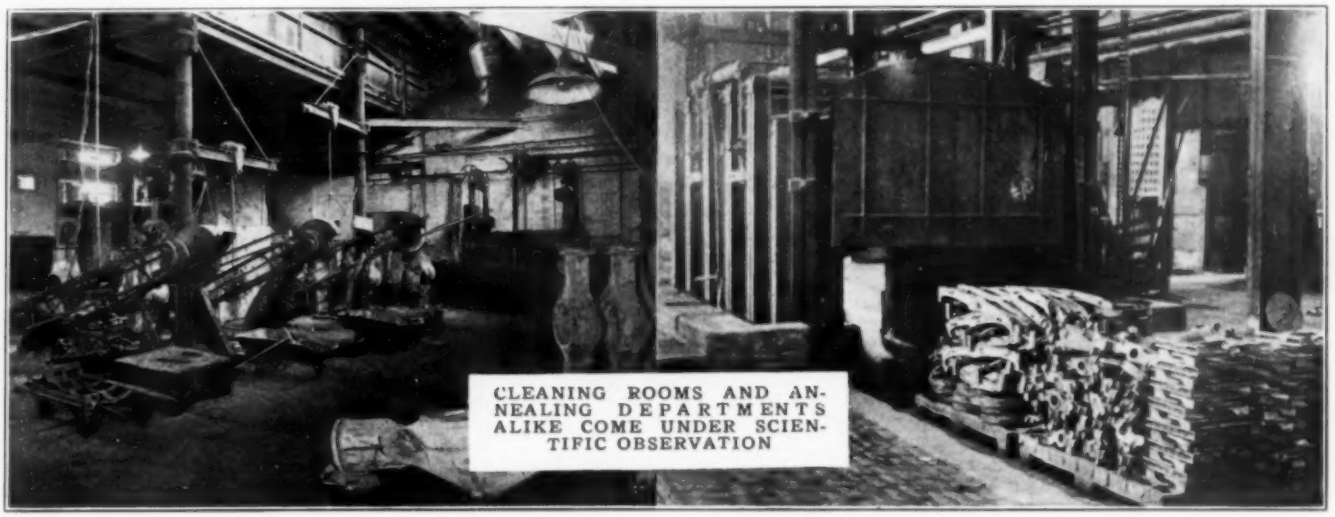
Research in each case is assigned to the plant believed to have the most suitable personnel and equipment for the purpose after recommendation along these lines by the director. Such an investigation is conducted at joint expense. It requires the immediate supervision of a properly qualified man who in many cases for a time may be the operating head of the member plant. In every instance this individual is held responsible. The serious manner in which the work is carried on will be apparent from this. The man on the ground making an investigation is given all possible assistance by the director who periodically visits the plants for personal participation in the researches under way. An exhaustive record is kept of every detail of each research. Therefore, the complete series of progress reports on any investigation is convincing.

The group's investigations to date have included abrasives, annealing, core practice, facing sand, gas cutting, furnace practice, the presence of slag in castings, and welding. Some of these researches have reached the stages where important facts have been established. Others promise to require considerable additional time for thorough prosecution. A few have had to be temporarily suspended or modified because business conditions interrupted production of some special classes of work.

Among the latter is the investigation of abrasives. It was demonstrated early in this research that the performances of grinding wheels cannot be compared satisfactorily unless the grinding is restricted to the same design of casting. Of course other factors should be maintained as constant. In demonstrating variable results caused by changing the design of the castings ground it was found that one wheel might remove in a given length of time 75 per cent more metal by weight from one class of casting than it would from another class. Lack of continuity of manufacture of the particular castings selected for this test temporarily has suspended this comprehensive investigation. Sufficient progress was made to show that a reliable measure of grinding wheel efficiency is in the calculated total cost per pound of metal removed. This cost is made up of the purchase price of the wheel; the compensation paid to the operator during the life of the wheel; and the overhead grinding costs assessed per grinding wheel per hour arrived at by the life of the wheel and by the inclusion of such items as power, maintenance of grinding stands, etc. The time element has been found to be satisfactorily cared for in the factors enumerated and in the weight of metal removed in the grinding operation.

The thoroughness with which every possible factor is considered in a group research may be appreciated better if details covering certain investigations are outlined. Important features involved in the facing sand investigation relating to certain laboratory tests which are necessary auxiliaries to foundry tests, are described in two technical contributions which will be presented by R. J. Doty, of the Sivyer Steel Casting Co., in papers at the 1922 convention of the American Foundrymen's association. This facing research is most comprehensive and to date has been conducted at two group plants. It is of such a nature that rapid progress cannot be expected in all its phases despite constant diligent study.

The research into core practice presents another problem of large proportions. In it are included the desired ingredients for the several kinds of core mixtures required; the correct proportions of these ingredients; the most practical method of mixing the ingredients; the most economical way of making the various kinds of cores in the core boxes; the proper ovens, temperatures and periods for drying the various classes of cores; and the most satisfactory methods of storing and handling the cores after drying. All of these require laboratory tests of numerous kinds to determine the actual unit strengths of green and dry core sand mixtures; the degree of permeability of cores of every kind; and other factors. The effect and the desirable extent of rodding the cores is studied. The required permeability of cores in each of several important and vastly different locations in the mold is a necessary feature of a thorough investigation of this kind. The relative importance of the skin of the core and how best to form it are two related, but really separate problems.

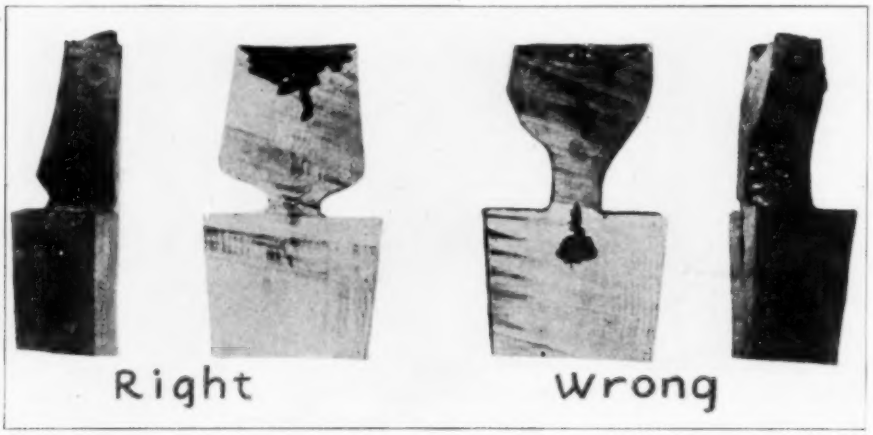


CLEANING ROOMS AND ANNEALING DEPARTMENTS ALIKE COME UNDER SCIENTIFIC OBSERVATION

A most important detail of this research lies in the use of heap and other refuse sand in various core mixtures. Foundrymen know the difficulties experienced in trying to use heap sand with oil as a binder in core sand. This has baffled the United States bureau of mines in its praiseworthy attempts to help the industry. Hundreds of tons of castings are being lost every month and more are being imperfectly made because of improper cores. Any such condition as that is sufficient justification for the group to attack the problem vigorously.

The investigation to eliminate slag from the interior and surface of castings is one that many readers would not perhaps fully appreciate without explanation. Some consumers of steel castings know only too well that slag spots in castings to be machined cause much trouble. The average user cannot be expected to appreciate the

many factors that may cause them. The study of this problem is most comprehensive and includes the following details: Tapping the heat and subsequent treatment of the slag on top of the metal to keep it separated from the molten steel as it is poured; the comparative results and incidental complications apart from the slag proper that follow the use of lip-ladles, teapot-ladles and bottom-pouring ladles; the linings of the large as well as the hand or shank ladles from which the steel finally is poured into many small castings; the type of mechanical skimmer found best to employ; control of the manual operation of skimming; and the utilization of skim-gates for the castings. The mold itself may form slag if its composition is such as to permit its fluxing beyond the bare skin of the facing in the short time when it is subjected to the highest temperature in pouring.



RESULTS OF INVESTIGATIONS ARE PLAINLY STATED AND SUGGESTIONS FOR IMPROVEMENT ARE VISUALIZED—THE VALUE OF A LARGE NECK RISER IS UNMISTAKABLE

The study of ladle linings as one of the numerous factors involved in the slag research is a sub-investigation of no small proportions. The group, in its search for suitable refractories for this purpose meets a problem which confronts only those who pour hot steel required for thin sections. The temperature fluxes a poorly selected ladle lining. In this research it was found that certain materials apparently suitable for lining mixtures would successfully withstand a much higher temperature than is obtained in making electric steel; but that when brought in contact with molten steel at a temperature considerably below the fusion point of the materials, the latter actually exploded, so sudden and violent was the disintegration. Search of technical data on refractories confirmed the surmise as to the cause for this and indicated as one result, the advisability of using a lining mixture which would quickly vitrify, but only to a shallow depth. After developing a suitable mixture, it is necessary to ascertain how many fillings each vessel may receive before repeated contact with the molten steel starts an undesirable fluxing action. As soon as that begins, slag forms and gravity eventually raises it to the surface of the liquid steel. From the foregoing, the vast amount of work entailed, in the effort to completely eliminate slag from steel castings, may be appreciated.

The research into annealing covers not only a fairly wide range of temperatures for the soaking heat, but the proper time for bringing steel castings to that heat; the most effective period for soaking at maximum temperature for each of the several widely varying sections of castings made; the correct method of cooling the castings after soaking; the effects of reheatings and quenchings in various media; and the proper regulation and distribution of heat in annealing ovens. The variations in temperature adapted to all kinds of steel produced are part of the research. In comparative tests to ascertain the proper procedure for each grade of steel to prevent wrong conclusions through the possible operation of obscure but variable factors, specimens poured in the same manner from one typical heat for the sole purpose of these experiments are treated in a great variety of ways. Annealing has received much more attention since the manufacture of ordnance castings was undertaken during the war. The possibilities of heat treatment for steel castings are enormous, as demonstrated by the widely varying results in physical properties ascertained by tensile, impact and fatigue tests, on specimens made in the same heat, subjected to treatments differing in each of many details, that to the layman would seem to be of no consequence.

Rigging for Molding Cast Iron Closet Tanks

Question: We should appreciate all the information you can give us regarding the molding of low cast iron closet tanks. For instance the molding methods, type of equipment required, machinery, flasks and any other information along these general lines.

Answer: Cast iron closet tanks form a highly specialized branch of the foundry industry and involve the use of specially designed molding machines. The molds are made and poured mouth down, entirely in green sand, in two-part iron flasks accurately machined and fitted. The drag, supporting the high green sand core, is made on a plain jolt machine, the cope is rammed on a combined jolt-ram, stripping-plate machine and the two parts of the mold are assembled on a third special machine.

An iron corebox, made in two parts for convenience in finishing, is placed on the plain jolt machine. It is provided with suitable lugs on the lower side by which it may be clamped to the table of the machine, and with a flange on the upper side by which it is clamped to the drag. The drag is tapered and requires no bottom plate. It also is provided with a rectangular bar extending across its width and to this, by means of a tapering pin, is attached the arbor which reinforces the high green sand. Core-sand is shoveled through the open bottom of the drag flask and both core and drag are jolted at the same time. The bottom is scraped off flush and then the corebox and drag, still clamped together, are lifted by a crane and rolled over. In this position they are lowered onto the special stripping and closing machine. The drag rests on a table supported by a plunger extended to its limit. The clamps are knocked off, the plunger slowly descends, the lugs on the corebox engage stops on the side guides which hold the corebox at that point. The plunger keeps on descending, carrying the drag with it and also stripping the core down out of the box.

The cope is rammed on a jolt-ram stripping plate machine. After the sand is rammed, the stripping plate is elevated, carrying the cope to a height sufficient to clear the pattern. It then is picked up by the crane and lowered into place on the third machine, occupying the same position as the drag a few moments previously. The long plunger supporting the combined drag and core once more is placed in motion and the core is pushed upward into the cope. When the flanges of the cope and drag come in contact they are clamped together and the complete mold is lifted off by the crane and placed on the floor.

Foundry Cutting and Welding

Castings Should Be Segregated According To the Size of the Risers So That Operators Can Work with the Minimum Interruption, Because of Changing Tips, Altering Pressures, etc.

BY G. O. CARTER

OXYACETYLENE cutting is an important part of the manufacturing process in foundries and always is localized. For that reason the gases for the blowpipes can be supplied by pipe lines, and the foundry floor can be kept entirely clear of cylinders. This saves considerable handling of cylinders and is one of several operating economies that result from piping the gases. Where acetylene is piped to the cutting or welding station the generator should not be located immediately in the foundry, but in a separate building, so situated with reference to the storage platform for oxygen that one can attend to both gases. There must be an adequate supply of fresh water for the generators and provision should be made for convenient disposal of the sludge. Several reliable types of acetylene generators are on the market, and salesmen in every locality who will supply special information on request. The initial acetylene pipe line should take into account not only existing needs, but the possibility of future expansion. All-welded lines are tendering satisfactory service wherever they are in use. Their original tightness can be determined by the pressure and hammer test. Due to the character of construction, a line that has passed such a test satisfactorily should not require any outlay for upkeep or repair for many years.

Oxygen should be piped to the foundry from an oxygen storage and manifold room, so located that it will be easy to transfer cylinders from a railroad car or truck. Reserve oxygen cylinders should be stored on a platform level with the car or truck body, so that it will not be necessary to lift or lower the cylinders. If a level platform is used, the cylinders can be stored on end instead of on their sides, a custom prevailing in many places.

3-*Section Manifold*

Cylinders for immediate use should be rolled on end from the storage space to a small manifold room close by. As many foundries do considerable welding, as well as cutting, it is of advantage to use a low pressure pipe to supply the oxygen to the welding station where the pressure need not exceed 30 pounds. This welding pipe line therefore can be brought to the manifold and combined with the cutting system in a manner to utilize a considerable part of the oxygen remaining in cylinders after the pressure has fallen below the working pressures demanded for cutting. This may be accomplished by means of a three-section manifold.

In operation, one section of the three-section manifold is supplying oxygen to the feed line for the cutting station at a pressure of approximately 150 pounds. Another section of the manifold, composed of cylinders, which had previously served the cutting station until they could no longer maintain a pressure of 150 pounds, is supplying the welding line. These cylinders would feed the pipe lines to the welding station at a pressure of approximately 30 pounds. The third section permits the removal of empty cylinders which have been exhausted on high pressure cutting and low pressure welding lines and the substitution of filled cylinders which then stand by for high-pressure line service on the next shift. This section exists merely for the purpose of permitting the exchange of empty cylinders for full ones, so fresh cylinders will be immediately available and no time of cutting and welding operators will be lost.

Regulator Troubles

In this combination high-class, large-capacity regulators are used between the outlets of the manifolds and pipe lines. These regulators, because each serves a separate line, do not require frequent adjustment. To avoid regulator difficulties that might result from cold weather, it has been found advisable to install a small steam coil near the regulators. In fact, it is desirable to keep the temperature of the manifold room well above the freezing point at all times. It is customary to use 10 cylinder manifolds, as this insures a sufficient supply of gas for several hours, even in a busy foundry. This makes it possible for one man to attend to the oxygen manifold and look after the acetylene generator, which ought to be of sufficient capacity to supply acetylene for an entire day from one charge of carbide.

The oxygen pipe lines should be welded lines, carefully cleaned of oil, then tested to 500 or 600 pounds pressure to make sure of tightness. The valve should be controlled by well-made station regulators, so pressure regulation will be thoroughly dependable. These regulators ought to operate for long periods without giving trouble, because they do not have to be taken off cylinders and put on cylinders constantly, as is necessary with regulators when individual cylinders are in use. One of the advantages of having a steam coil near the oxygen regulator is the fact that warm oxygen is appreciably more efficient than cold oxygen, especially on heavy cutting, and for this reason, the coil is sometimes supplemented by a steel jacket placed around the pipe near the regulator.

The blowpipe is an important part of the installation, for it is in this apparatus that the two gases are combined for the cutting operation. Correct designs, good materials, and proper workmanship are the most important factors. Different blowpipes have different characteristics. One type, may be designed for high efficiency, another type for special freedom from backfiring, and yet another may aim at minimum weight. Each user will determine for himself what characteristics he requires in the tool and he will judge the blowpipe accordingly.

Whenever a blowpipe is used it should be kept in good condition, so that gas passages are clear and the joints are leak proof. The proper tip should be used for the cutting work being done. Many operators have a tendency to use oversize tips, but this is not good practice owing to the unnecessary waste of the gases.

For many kinds of cutting it seems advantageous to have the work lifted up, so that the risers will be on a level with the operator's hips. In such cases, cutting benches or frames should be provided to hold the castings. This might be called a part of the oxyacetylene installation because it is an important factor in the economical use of gases and in promoting clean cutting.

Preheat Castings

It is desirable to have preheating equipment and annealing bins at the welding station. If the castings in general are not composed of large units, the preheating should be performed in

From a paper presented at the American Foundrymen's convention held at Rochester, N. Y., June 5-9. The author is connected with the Linde Air Products Co., New York.

fixed furnaces, but either oil or gas burners should be provided for preheating large castings. Maintenance and repair welding and cutting can be used to great advantage in the foundry. Portable outfits, consisting of oxygen cylinder, oxygen regulator, acetylene cylinder and individual regulator should be used unless this work is to be done in close proximity to pipe lines. Such an outfit might well be called an emergency outfit and probably would be placed under entirely different administrative control than that having charge of riser cutting equipment. The major uses of the process in a foundry are in connection with production. Maintenance and repair welding and cutting more naturally come under the maintenance engineer or master mechanic.

Clean Metal Imperative

Probably the most important things connected with cutting are the character and condition of the risers. It is highly desirable that they should be sound and that the necks should be thoroughly clean. The soundness of a riser depends upon the molder and the steelmaker. Defects which show up at the neck of a riser are things which the foundry management always is fighting. The oxyacetylene cutter considers himself fortunate if he finds 75 per cent of the risers thoroughly sound. The necks of the risers can be cleaned either by scraping or by sandblasting. Where the risers are scraped the work should be done by a helper, as the operator's time is too valuable to expend on a purely preparatory operation. Even a little sand interferes seriously with the cutting process, so the most satisfactory method of cleaning risers is to sandblast the necks, because this removes practically all the sand.

Whenever it is practicable to cut the risers while they are still warm it is desirable to do so, because there is a saving of approximately 10 per cent in gas consumption. This is because the excess heat renders the slag more fluid, thereby improving the cutting efficiency. It is difficult to bring hot castings to the cutting frames, and the subject of hot cutting is at the present time perhaps of more theoretical than practical importance, but this is a subject that is receiving attention, and it is by no means assured that it will remain in the theoretical category. It is decidedly something to keep in mind, and wherever feasible the cutting of warm or hot risers undoubtedly repay the foundry manager for a reasonable amount of trouble in handling the work.

One of the most interesting and useful developments in the study of oxyacetylene cutting practice in foundries is the segregation of castings having risers that are approximately of a size, so that the operator can use the correct blowpipe tip and gas pressure. Where the castings are not segregated, if there is any considerable variation in sizes, the tendency is for the operator to select a tip that is capable of handling all the work, and the pressures naturally are set to enable him to cut the largest of the lot. It is easy to see how this might result in serious waste of gases.

In many foundries risers will be from 6 to 8 inches in thickness, while the bulk will be only 2 to 3 inches in thickness. If a blowpipe is set so that it will cut the 8-inch risers, the full gas flow will be at the rate of not less than 700 feet of oxygen and 50 feet of acetylene per hour. For cutting the 2-inch risers the gas flow should not be greater than 200 feet of oxygen and 30 feet of acetylene per hour.

Ten Important Points

1. In the larger foundries a new type three-section oxygen manifold will pay rich dividends on the investment and provide oxygen for welding at almost no cost.
2. Piped oxygen and acetylene installations are desirable in large foundries because they obviate handling cylinders for regular production cutting and welding in the foundry proper.
3. To obtain the best results oxyacetylene equipment must be regularly inspected and properly maintained.
4. The managerial phase of gas cutting and welding is as important as the technical phase in securing maximum efficiency and economy.
5. Repair welding in the foundry is well worth while and should be under the supervision of the master mechanic rather than under a production official.
6. Oxyacetylene cutting of cast iron is often a useful operation but it is not economical for regular cutting of risers in gray iron foundries.
7. New uses of oxygen and acetylene are being discovered almost daily and foundries can well afford to follow the lead of steel mills in adopting many of the new uses and practices.
8. Segregation of castings according to the sizes of the riser necks may be counted on to more than repay the expense incident to such segregation.
9. Proper elevation of work and comfort of operators are worthy of close attention.
10. Recent developments in the oxyacetylene welding and cutting industry are such that no one can safely accept conclusions as to its limitations, unless these conclusions are based on a knowledge of present conditions. For this reason most foundrymen and others can well afford to make an entirely new survey of cutting and welding with regard to the possibility of introducing or extending special applications of the processes in their establishments.

The segregation of castings into graduated sizes has been adopted by many progressive foundries and might well be adopted in many others. Little labor is required to place the castings in groups. Additional labor certainly would not exceed one man, whose compensation would be probably 40c per hour. Assuming that the castings have been properly segregated and that the cutter has disposed of the heavier risers with the most efficient pressures, he next adjusts his blowpipe for the cutting of the largest remaining series. This becomes a natural and justifiable thing to do where there is considerable cutting in each series, but it would not be either natural or economical if the castings were indiscriminately handled. If the cutter has an hour's work on the 2-inch risers, it is quite clear that in that hour he saves the difference between 700 cubic feet of oxygen and 200 cubic feet required for the different sizes the actual saving is 500 cubic feet or two and one-half times the volume of oxygen required for the work on the 2-inch risers. The saving in acetylene is 20 cubic feet. These savings at the current prices of the gases amount to between six and seven dollars.

Divide Into Groups

It would be difficult to segregate risers into a great number of groups, but it should be possible to use certain definite sizes of risers in the molding operation to facilitate separation at the cutting frame. Four groups, which do not require an excessive amount of handling for the average foundry might be sorted to take in risers of 2, 4, 6 and 8-inch risers. With the segregation of risers into such groups, and the use of tips and pressures best suited for cutting each group, the savings alone should run from $15.00 to $20.00 a day for each operator. Such savings are well worth the consideration of foundry managers. Though there are many foundries that have adopted the segregation of castings as the orderly and economical way of handling cutting, I believe that only a few managers have a real conception of the amount of gas they are saving. Foundrymen cutting risers 8 inches in thickness and larger can well afford to insist upon their operators' cutting with the proper tip and setting the regulator at the proper pressure for a given size, even though only one of a size is cut. A riser 10 x 12 inches costs more than $1.50 to cut. The total cutting time for such a riser would be about 10 minutes. The time necessary to get the correct adjustment would certainly not be more than one minute, and this at a 60c an hour rate for a cutter, would cost one penny. By getting the best pressure for the work the saving would be at least 10 per cent over the cutting costs when the operator depends on haphazard guessing, because he must always be sure of sufficient pressure, which, in such castings, means excessive and unnecessary pressures.

Some cutters believe that excessive pressures enable them to cut faster. This

is a fallacy, because in cutting a given thickness of metal the rate of cutting does not depend on the quantity of oxygen but entirely on the time interval required for the chemical reaction which takes place. When excessive pressure is used, a large amount of oxygen is blown through the cut without in the least helping to promote oxidation. The excess oxygen might have a slight beneficial effect due to the higher velocity of the gases which tends to blow the molten oxide from the kerf, but any such gain is not worth the oxygen wasted on it; besides, where correct pressures are used there should be no difficulty from choking of the slag in the kerf. Moreover, it has been noted in many instances that correct pressures are not only more economical in gas consumption than excessive pressures, but result in even better cutting speeds.

Still it should be borne in mind that a cutter will be almost sure to get into difficulty if his pressures are not high enough. Doubtless, it is his knowledge of this fact that actuates the operator who guesses at his pressures in almost a universal tendency to allow a generous margin of safety resulting in excessive pressure and consequent waste of gases. Blowpipe manufacturers provide cutting pressure tables for use with their equipment and the pressures prescribed in these tables for different thicknesses of metal should be closely observed and followed. As it is always possible that pressure gages may get out of order, it it advisable to have the gages checked against a good master gage at frequent intervals, or in the absence of this service, operators should be checked by a test engineer who will direct them to cut under varying pressures until the best effective pressure for each thickness of metal is noted. If the best effective pressure does not check with that called for by the manufacturer of the blowpipe it is pretty conclusive evidence that the gage is not functioning accurately and that it should be either replaced or adjusted.

Blowholes Cause Trouble

Operators who are using correct pressures for cutting sometimes encounter difficulties due to blowholes in the riser. While it may be possible by the use of excessive oxygen pressure to continue the cut across blowholes of even an inch or more in diameter, such defect in risers always give considerable trouble and there is a much better way to handle the situation than by a wasteful use of oxygen. When a cutter who is using the correct pressure encounters a blowhole he should at once chance his position to permit of cutting from the other side of the riser, as this has been found much better than trying to *hog* his way through after hitting an obstruction. Experienced operators can feel blowholes and such operators switch to cutting on the opposite side of the riser with practically no loss either of time or of gas.

Some operators instead of stopping a cut when they feel a blowhole and starting from the opposite side, work around the riser, retarding the bottom of the cut as they advance the torch tip. This tends to leave a more open kerf and to keep the oxygen jet away from the blowhole until enough metal has been cut away to permit the cutting jet to work altogether on solid meal instead of encountering the blowhole, so the cutting operation can be completed normally. This same scheme of cutting around a riser often is used in cases where heavy cutting, such as 20 inches or more, is required, yet where the facilities do not permit an ample supply of oxygen for this heavy work. By cutting around the riser the actual depth of the cut at any time is not over two-thirds the thickness of the riser. This cutting around the riser is an interesting trick and takes care of difficult situations, but it is not the best practice, which is to have a big enough oxygen jet and a sufficient supply of oxygen, through a pipe line or manifold, to permit of straight-through cutting.

Cut Cost Lessened

The cost of making the cut is not the only problem involved, because if a cut is not along the line desired additional cutting will be required to trim it to shape, or the excess metal must be removed by grinding. The major reason for using cutting benches or frames is so the work will be at a level where the operator can control the direction of his jet exactly and remove the riser with one clean cut. Incidentally, the operator will naturally work faster and will probably pay more attention to the gas pressures, if he is working in a comfortable position.

Theoretically there seems to be no limit to the thickness which can be cut with oxyacetylene flame. Within the past year or two, cuts have been made measuring 3 and 4 feet in depth. The quantity of oxygen required for such heavy cutting requires special provision for regulators, manifolding of cylinders etc. This kind of heavy cutting also necessitates the use of special tips so that all the oxygen the torch can handle may flow through the jet. Unless a foundry is properly equipped for cutting exceptionally heavy risers and has operators who are experienced in the work, it probably would pay to call in a special operator whenever one of these difficult cutting jobs is encountered. Study of heavy cutting is being made, and apparatus capable of cutting almost any riser that can be poured probably will be available within the next year.

Anyone who has observed oxyacetylene cutting probably wonders what effect the cutting has on the metal. It is safe to say that dozens of investigations have been conducted on this question, as it is a particularly important one in certain lines of cutting. In the cutting process the metal is heated to a high temperature in the region of the reaction, but it cools relatively fast because the body of the casting is cool and conducts the heat away from the cut surface. On this account the extreme edge of the cut, where the intensity of heat has been greatest and where there is also a cooling action from the air, is of fine grain structure and somewhat hard. The effect of heat on the grain structure is observed under the microscope to extend from the cut surface to a point about three-sixteenths of an inch from the cut surface, beyond which all evidence of granular metamorphosis seems to cease. It is clear, therefore, that the hardening effect of cutting is localized, and if even an average machine tool cut is taken across the surface of the oxyacetylene cut, all of the affected metal is removed. Besides the effect on the grain structure, the cutting heat produces another effect on castings unless proper precautions are taken—it sets up strains of a more or less serious character. These tend to warp the castings, the degree of distortion depending largely on the shape of the section of the casting where the heat was applied.

Castings Warp

On some castings the warpage is considerable and steps must be taken to overcome the difficulty. One way of doing this is to heat the entire casting to a dull red (at which temperature the cutting is done), after which the casting is permitted to cool slowly. Another way is to cut small sections at a time, permitting each section to cool down completely before undertaking the next cut. This method does not entirely relieve the strains in the casting, but largely prevents the warping. Where long cuts are made warping is primarily due to the fact that the body of metal is cold and that only one edge is heated. So long as it retains its heat the cut surface is capable of adjusting itself to the main body of metal, but when the metal along the edge of the cut is cooled down to the point where it develops appreciable strength, it no longer yields but pulls as the metal continues to contract in cooling. This effect is exactly the same that occurs in the cooling of a bar of metal, except in this case the bar is really an integral part of the whole. If the main section is relatively light and is long, the pull of the section which has been heated will cause warpage. If the main section is relative-

ly heavy, there will be no warpage but there may be strains.

A thorough annealing of the casting should restore the proper grain structure of the metal and should entirely relieve all strains. If the casting is warped, however, relieving the strains by annealing will not bring the casting back to its original shape. To conclude the discussion of the cutting process, the writer desires to mention a relatively recent development, namely cast iron cutting. Apparently, this form of the cutting process is not advantageous for foundry use at present, as the cutting action is slow as compared to the reaction in cutting of steel, and much larger quantities of oxygen are required. Cast iron cuts can be made, however, which closely resemble steel cuts, being real cuts and not merely sections melted out.

Oxyacetylene welding is not used in the average steel foundry to the extent that the cutting process is employed, but it merits most careful consideration in foundries of all kinds. When properly made, the oxyacetylene weld should be as strong as the original base metal of a steel casting. It is highly important, however, that the proper filler rod should be used in welding steel castings. For example it never is advisable to use Norway welding wire, as the deposited metal would be wrought iron and, therefore, of different composition and strength than the metal in the castings. However, if the welding rod is properly selected to give a deposited metal similar in composition to that of the casting, the oxyacetylene weld metal can be counted on to thoroughly bond with the original metal and to be of almost the same composition. Being in a cast condition, the deposited metal should be equal in strength to the original casting.

Avoid Cooling Strains

In welding we must watch the effect of heat on the casting to avoid warping and the setting up of strains. Neglect of this precaution accounts for many unnecessary failures of castings which have been otherwise correctly oxyacetylene welded. Where welding in done on a large section, a considerable area naturally will be at quite a high temperature, and on cooling down will undergo severe contraction. If this effect of the heat is permitted to cause failure of the metal, it is the fault of mechanics and is not a failure of welding. There is one certain way of preventing this bad effect of heat, and that is to have the entire casting heated so that the cooling down will be uniform in all parts. Incidentally, if the quantity of welding amounts to even 3 per cent or 4 per cent of the total volume of the casting, the heating of the casting in a furnace or by an oil or gas and air heater will probably save enough oxygen and acetylene to more than offset preheating cost. Preheating is advised whenever castings are oxyacetylene welded, and if it is not practicable to completely preheat a casting it should at least be locally in the casting when it has cooled down. It is of utmost importance that the cooling down of welded castings should be a slow process, and to insure slow cooling a welded casting should be covered with sand or should be placed in annealing ovens or bins. By doing this the castings will cool down from the annealing temperature so slowly that the cooling will be uniform.

Gray Iron Practice

In gray iron castings oxyacetylene welding is used almost altogether. In this work the welding rod should be made of gray iron of excellent quality that is high in silicon content, and a flux should be used to work the oxide out of the molten bath. Preheating is even more important in the welding of gray iron castings than in the welding of steel castings, and the subsequent annealing is equally as necessary. The actual making of a weld in gray iron is an easy operation, though it is often a long-drawn-out and hot one. In gray iron the resulting weld should be of even better quality than the casting, because the deposited metal can be cleaned so thoroughly. In most gray iron foundries the welding is being placed on a production basis, the casting being heated in annealing ovens and then carried to the welding stations where they are properly welded. They are then returned to either the annealing bins or to sand piles where they are covered and allowed to cool down slowly. In some gray iron foundries the number of acceptable castings per hundred poured has risen very decidedly through the use of this real production welding.

Welding in steel foundries can well be given fresh consideration, because through use of a three-section manifold sufficient oxygen to do the welding will be obtained from the cylinders after they have been utilized for the cutting work. This oxygen may be considered as of no cost, because it is pure salvage. It does not pay to take the cylinders from one manifold to another, or to carry them from a cutting station to a welding station, but it does pay to save this gas if a three-section manifold is installed. In view of the excellent quality of the deposited metal obtained by the oxyacetylene process, the whole problem of welding should be studied thoroughly by foundry managers. In some cases, where welds are made by other processes, it will pay to add a layer of oxyacetylene welding owing to superior machining quality of the deposited metal.

Attention should be called to the numerous uses for the oxyacetylene process in maintenance and repair work. As this kind of work is separate and distinct from production work, it will pay to have a skilled repair welder and cutter rather than to depend upon one of the regular foundry operators. It is well for such a man to be a good mechanic to being an oxyacetylene welder and cutter.

Oxygen alone is used for burning out furnace tapholes when they become badly plugged with frozen metal. Oxygen alone also is used for drilling into skulls and salamanders. These uses for oxygen are assuming great importance in the steel mills and oxygen burning is also becoming more and more a recognized operation in modern foundry practice. The oxygen cutting torch is used in cutting out structural steel, sheet steel or cast iron parts to be removed in demolition work. When making changes in plant structures (such for instance, as the installation of new cranes) old columns, frames, etc., are frequently removed, and these changes can be made with a few minutes notice with the cutting torch used either for burning out rivets or for cutting through sections. When new parts are ready for installation, changes frequently can be made during the noon-hour, or on holidays, thus saving much productive time.

Used for Dismantling

Cutting is used in removing parts of furnaces, cupolas, gas producers and numerous other kinds of equipment employed in foundries. Constructively it is used in shaping structural and sheet steel which is to be used in new equipment. Oxyacetylene welding is being used more and more around all industrial plants for welding of broken parts, welding patches into sheets when corrosion has necesitated cutting out bad spots, etc. In new construction welding is most useful for installing pipe lines, making steel tanks, bins, oil receptacles, gear guards, etc. The master mechanic who understands the possibilities of oxyacetylene welding can keep a welder busy all the time around a foundry. In some places the oxyacetylene welding torch is being referred to as a one-man machine shop, which clearly indicates its adaptability to almost any welding or cutting problem.

Promoted to Managership

J. Martin Duncan, follow-up engineer, the Detroit Steel Casting Co., Detroit, has been promoted to be general sales manager of the same company. He is succeeded by E. R. Young. Mr. Allen, formerly sales manager has been made assistant general manager.

System Rules Malleable Shop

Records of the Progress of the Work in a Large Foundry Are Kept on Simplified Forms—Four Men Handle Routine for More Than Two Hundred Molders—How the Work is Scheduled

BY H. E. DILLER

HUNDREDS of patterns going into the foundry with orders of from possibly a single casting to several thousand from the same pattern, require an exact system for keeping track of the work. The first requirement of such a system is accuracy which will enable the production manager to locate a pattern at any time and to find out just how many castings have been made from it. Also, it must enable the molder to know when the required number of castings has been made, and it should show the time spent on the job. While meeting these requirements it is important that the system be made as simple as possible.

FORM 118-16

CUSTOMER Rapid Co.,
Middletown, Ohio.

NO. OF PIECES 1000 PAT. NO. X 3145

SHIP VIA C. D. & T. Traction Freight

Ship 500 April First
" 500 May First

Hub Dust Felt Retainer

ORDER NO. 344415
REQ. NO. X 22210
DATE 3/1/23
WEIGHT EACH

DATE	NO. PCS.	TOTAL	DATE	NO. PCS.	TOTAL	DATE	NO. PCS.	TOTAL	DEL'Y REQUIRED

ORDER

Price_____

Terms_____

Pat. Eqt._____

Issued_____

Entd. on Order Record_____

FIG. 1—THE PRODUCTION DEPARTMENT MAKE OUT THIS FORM IN TRIPLICATE WHEN THE ORDER IS RECEIVED FIG. 2—FORM STAMPED ON THE COPY WHICH GOES TO THE TREASURER FIG. 3—RECORD CARDS ARE KEPT IN SEVEN BOXES ON A REVOLVING TURRET SHELF

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Customer: Rapid Co — Gates 4 — Patt. No. X3145

Name of Part — Aver. Wght. 1.5#

Date	Order No.	Pcs. Ordered	Total Ordered	Date	Order No.	Pcs. Ordered	Total Ordered	REQUIREMENTS	Bench No.	Bench No.
3/9	34415	X000						500 April 1st 500 May 1st	38	

Date	Defective	Date	Poured	Good	Total Good	Date	Poured	Good	Total Good	Date	Shipped	Total Shipped	REMARKS
		3/9	X96	185									

FIG. 4—THIS CARD KEPT IN THE PRODUCTION OFFICE AND SHOWS THE NUMBER OF CASTINGS ORDERED OFF A PATTERN, AND THE NUMBER MADE AND SHIPPED

The plan employed by the Dayton Malleable Iron Co., Dayton, O., combines both accuracy and simplicity. This company at its Dayton plant has eight air furnaces with a capacity of from 15 to 20 tons each, and frequently takes two heats a day from a furnace, although usually one furnace is down for repairs. When operating at full capacity, 210 molders are employed and the work in the production department is handled by a stenographer and three production men. However, if not more than 175 molders are employed the production control work may be done by three persons.

An order received by the company is sent to the general sales manager who examines it and makes a record in his own office as to the order and the price to be fixed for the castings. It then is sent to the production department which is in charge of C. P. Osborn. Accompanying the order is a statement of any promise made to the customer regarding production if any such promise has been made. However definite promises regarding production are not made unless necessary.

Makes Triplicate Orders

On receiving the order, the production department makes a triplicate copy. The original, shown in Fig. 1, is made on stiff paper and is sent to the shipping department. This gives at the top the customer's name and address, the number of pieces wanted and the pattern number. Below is a space for shipping instructions, in which are noted the route and the number of pieces to be shipped on certain dates, and any other instructions necessary for the shipping department. At the right is a space for the name of the casting, the order number, requisition number, date, and weight per casting. The remaining space on the front of the card is devoted to a column in which delivery requirements are noted, and to three sets of three columns; two columns of which give the date and number of pieces for each shipment, and one column in which the totals are kept. The back of the card also is ruled for two sets of these columns.

The first copy of this order is identical with the original, except that it does not have the ruled columns. This is sent to the foundry office. The second copy is made on a plain sheet of paper on which has been stamped a form for recording the price, terms, pattern equipment, date issued and date entered on the order record. This copy is sent to the treasurer's office.

All these three copies of the order leave the production department, but before they are sent out a copy of the order is made on the form shown in Fig. 4, which is retained in the production department. This is a card 9 inches wide by 7 inches high. These cards are kept in seven boxes on a

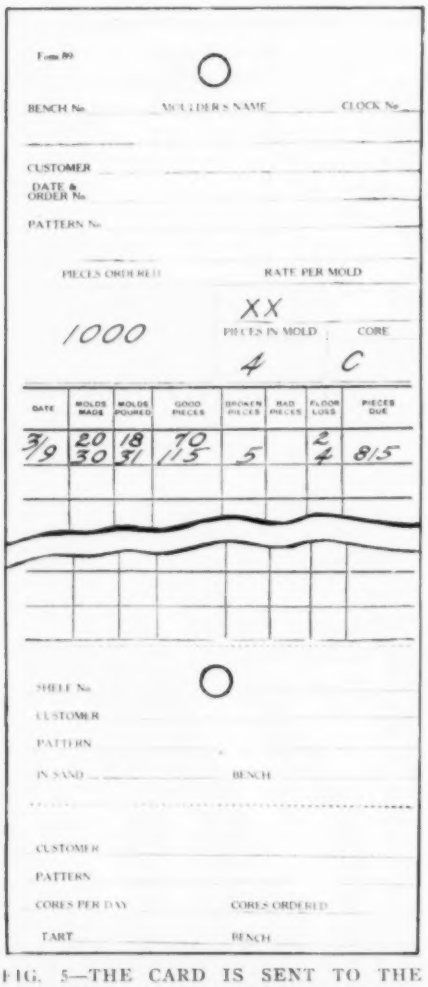


FIG. 5—THE CARD IS SENT TO THE MOLDER AND ONE STUB TO THE PATTERN VAULT AND THE OTHER TO THE CORE ROOM

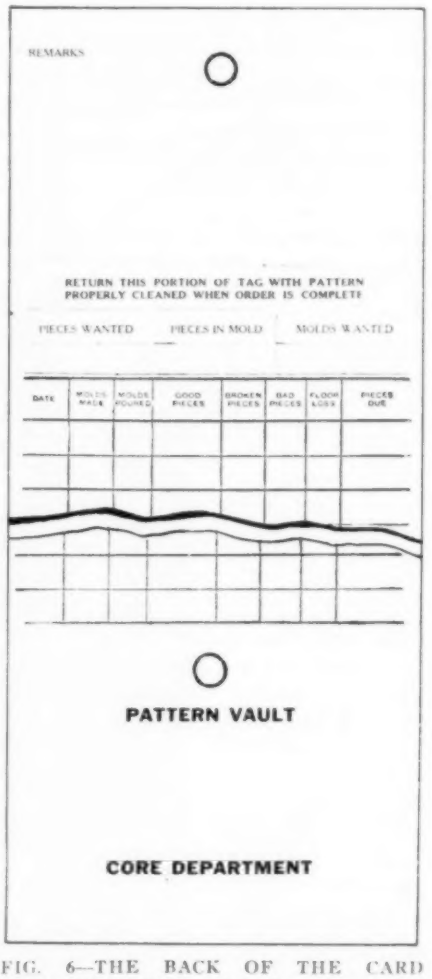


FIG. 6—THE BACK OF THE CARD SHOWN IN FIG. 5 IS USED FOR THE MOLDER'S CONTINUOUS RECORD OF HIS WORK

revolving stand in the center of a table as shown in Fig. 3. This allows four men, one working at each side of the table, to have ready access to the cards. Each box is numbered for identification and the clerk swings the shelf until the box he wants comes before him. The cards are filed according to customer's names. The largest customers have orders enough in the shop so that the cards from two or three of these customers fill a box. In such a case, the clerk easily can remember the number of the box containing the orders of the particular customer. However, holders for cards on which to index the customers whose orders are in the box, are fastened to the front of each box. In the one or two boxes in which orders are kept from a large number of firms sending in only a few orders, the cards are arranged alphabetically according to the customer's name. One box is used for orders pending, that is, which have not been sent to the foundry.

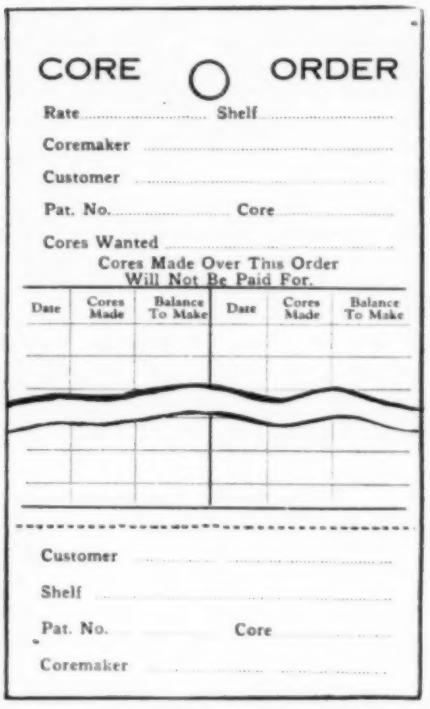


FIG. 7—THE CARD IS USED BY THE CORE MAKER AND THE STUB IS KEPT IN THE COREBOX STORAGE ROOM

Steel Clips Act As Ticklers

The top of the card is divided into 31 spaces numbered consecutively from 1 to 31. By placing a steel clip in the card at the number corresponding to the date on which work on the order is to start, the card serves as a tickler. After the card is placed in the active file, the clip is placed over the number corresponding to the date on which molding on the job should be finished. This gives the production clerk an indication of when a molder will be ready for another job, and he can make preparations for putting a new pattern in the sand.

A space is reserved for recording the customer's name, the name of the part, the number of gates on the pattern, the average weight of a casting, and the pattern number below the line of numbers on the card, Fig. 4. Under this is a section for keeping tab on the orders. Two sets of four columns each are laid off at the left. The first of these four columns is for the date the order is received; the second for the order number; the third for recording the number of pieces ordered, and the fourth for totaling the number of pieces ordered in case more than one order is received for casting from the same pattern. At the right of these columns is a space for noting the requirements, namely the number of castings to be made before a certain day, or each month. Two more columns are left on this row for marking the bench number, at which the molds are being made.

The entire space remaining on the card is used for recording daily production and defective castings. The first two columns are for the date and number of defectives. These are reported from time to time and subtracted from the number of good castings previously reported. Beside these two columns are two sets of four columns each, in which are marked the date, number of castings poured, number of good castings, and total good castings. The total for the good castings is found by adding the number cast to the previous total. The shipping record is kept in the next three columns headed, date, chipped, referring to the number and total shipped. A final column is devoted to remarks about the job. The back of the card is ruled like the front except that all lines above the columns for recording the orders in are omitted.

Card Retained in Production Department

All copies of the order, Fig. 1, which is made out in triplicate, are sent to other departments, but the card, Fig. 4, is retained in the production department. When the copy of the triplicate order reaches the foundry, the man in charge of the pattern vault makes out two forms, one for the foundry and one for the core department. Each form has space at the top for information regarding the job and below are ruled columns for re-

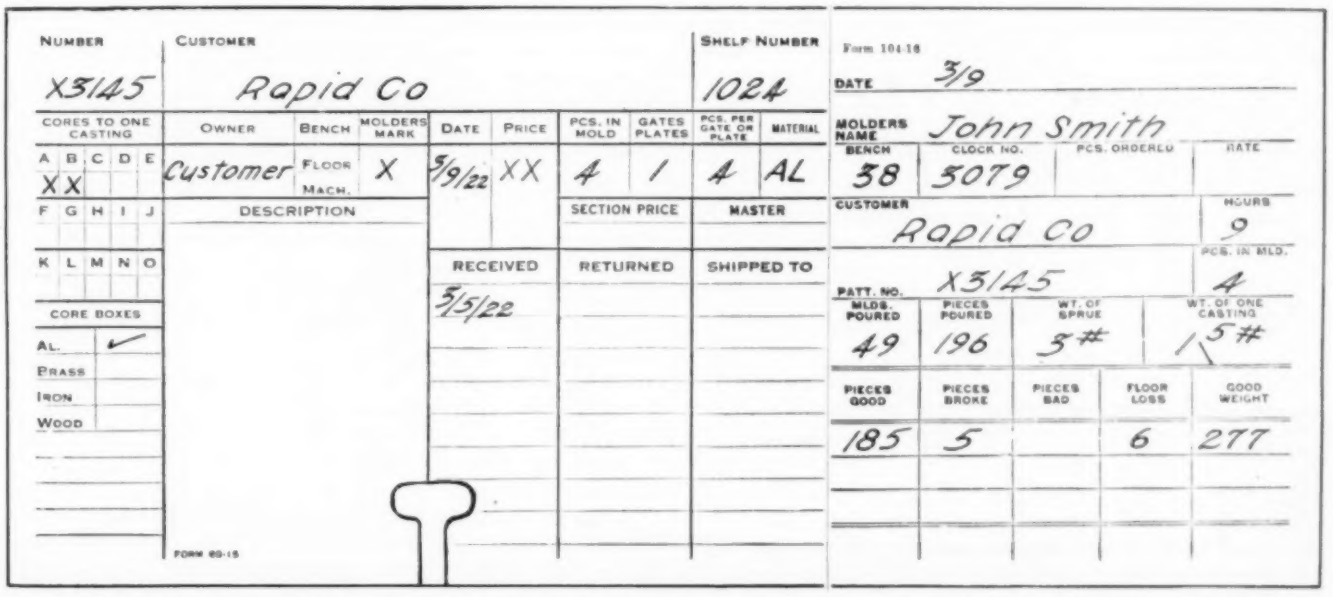


FIG. 8—CARD KEPT IN THE PATTERN VAULT TO RECORD THE MOVEMENTS OF THE PATTERN FIG. 9—THIS CARD IS FILLED OUT DAILY BY THE PRODUCTION CLERK ON HIS ROUNDS OF THE FOUNDRY

cording the number of the pieces made.

At the top of the molder's card, Fig. 5, is space for the bench number, and the molder's name and clock number. Below this are lines for the customer's name, the date and order number, the pattern number and a description of the pattern. Space also is provided for noting the number of pieces ordered, the piece rate per mold, number of pieces in a mold, and whether a core is used. Columns provide for daily marking the date, the number of molds made, number poured, total good pieces, broken pieces, bad pieces, floor loss, and pieces due. The record is kept by heats, so two figures usually will be placed in each column every day, excepting the one for pieces due. The figure for the pieces due is secured by subtracting each day the number made from the pieces due.

At the bottom of this card, Fig. 5, are two perforated sections, the one to be sent to the core department and the other to be kept in the pattern vault. The one sent to the core department has spaces for recording the customer's name; the pattern number and name, the number of cores wanted per day, and the total number ordered, the date the job was started, and the bench number where the cores are made. This card is sent to the foundry with the pattern when it is time to start the job. The one stub which stays in the pattern vault as a record of the pattern, has space for recording the shelf number on which the pattern is held in storage, the customer's name, the name and number of the pattern, the date the pattern is put in the sand, and the bench number of the molder doing the work. The second stub is sent to the core department. On it are recorded the customer's name, the pattern number, the number of cores per day, and the total number of cores ordered; the date to start making the cores, and the bench number of the coremaker working on the job. Columns are printed on the back of this card similar to the ones on the front of the card in which the molder's record is kept.

Card Sent to Coremaker

A card performing the same function for the coremaker as the molder's card does for him, is given to the coremaker. This core-order card, shown in Fig. 7, has a form at the top for recording the rate to be paid for the job; the shelf on which the corebox is kept; the coremaker's name; the customer's name; the pattern number; the corebox number, and the number of cores wanted. Below are two sets of three columns, in which the date, number of cores made and the remainder to be made are noted. A stub also is supplied with this form, to be kept in the corebox storage. This contains lines for the customer's name, shelf number, pattern number, corebox number, and coremaker's name. Like the molder's card this has a form printed on the back similar to the columns presented on the front.

A foreman in the foundry, representing the production department, selects the molder for each job. When the job is placed, the forms Figs. 5 and 7, which have been filled out are sent to the molder and coremaker respectively.

The first thing every morning a clerk from the production department goes around the foundry getting the record of the previous day's production from the cards, Figs. 5, at the molder's benches. This information is noted on a card, Fig. 9, and consists of the hours worked, the number of pieces in a mold, number of molds poured, number of pieces poured, number of good pieces, and the floor loss. The job is identified on the card by the date, molder's name, bench number, clock number, customer's name, and pattern number.

After a card has been made out for every floor, the production clerk takes the card to the trimming room where information is secured for filling in the weight of one casting. This is determined by weighing a number of castings on a weight-count scales. The trimming room also reports the total weight of good castings, the number of broken pieces, and the approximate weight of a sprue.

Sorted by Production Clerks

The cards, Fig. 9, completely filled out are then taken to the production department and after being sorted and arranged alphabetically according

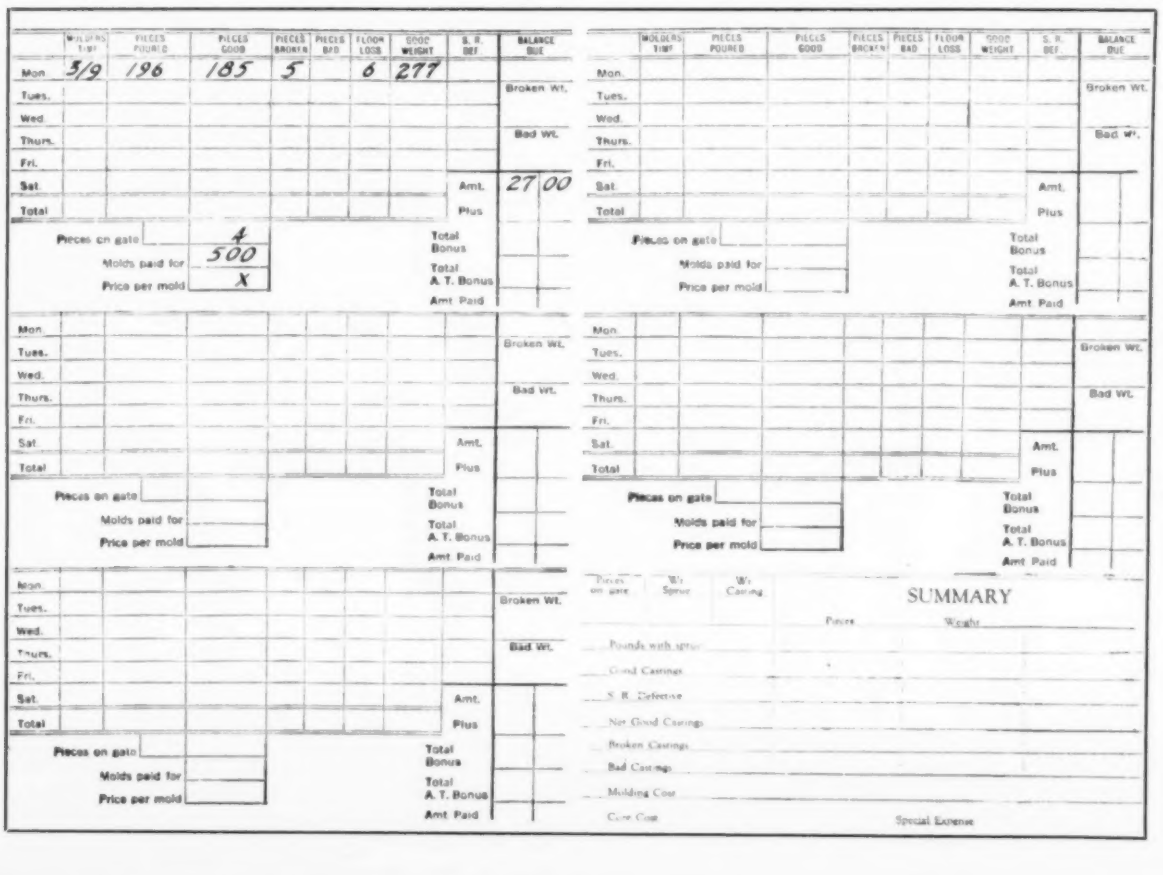


FIG. 10—DAILY PRODUCTION RECORDS OF THE INDIVIDUAL MOLDER IS KEPT BY MONTHS ON THIS FORM AND SUMMARIZED AT THE MONTH'S END

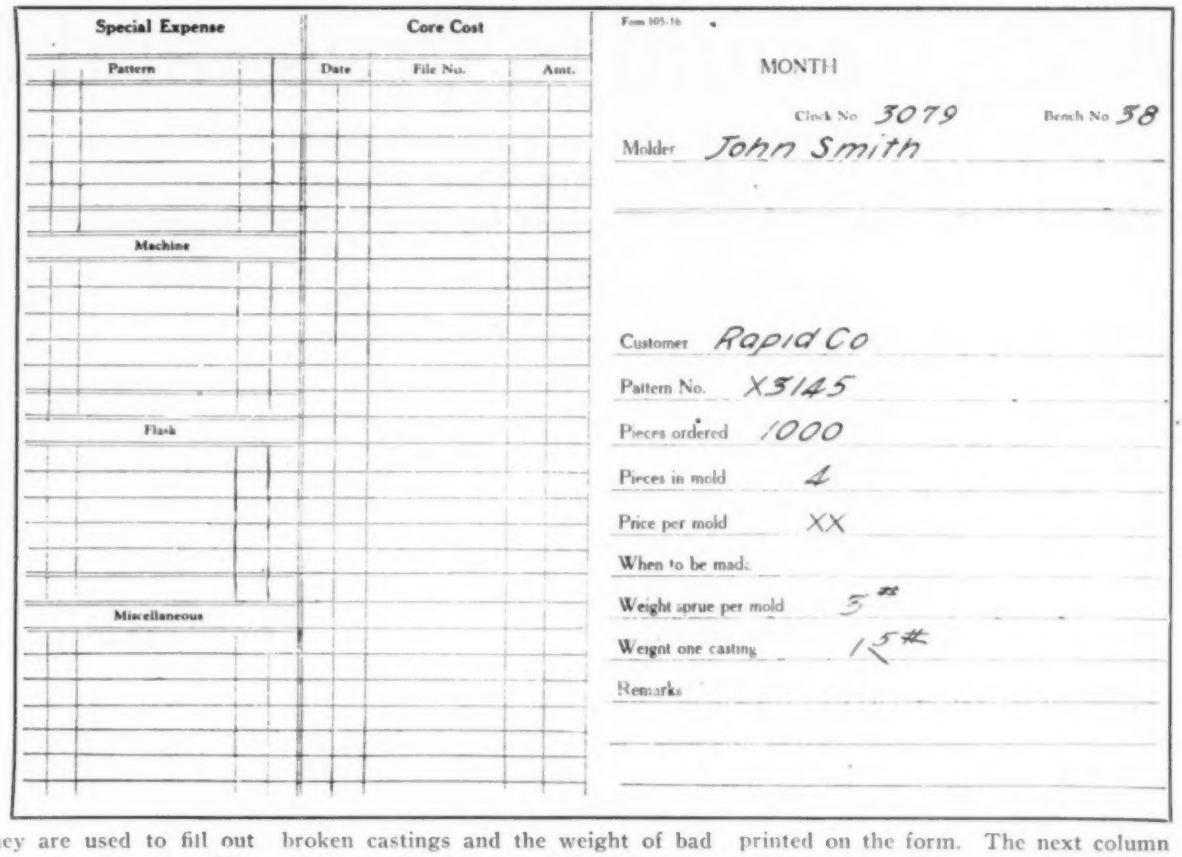


FIG. 11—AT THE RIGHT IS SHOWN THE FIRST PAGE OF THE FOUR-PAGE FORM MADE BY FOLDING THE FORM SHOWN IN FIG. 10 WHICH MAKES THE SECOND AND THIRD PAGE—AT THE RIGHT IS SHOWN THE FOURTH PAGE

to customers they are used to fill out the production cards, Fig. 4. The smaller cards also serve to make out the molder's pay roll on the form shown in Figs. 10 and 11. Records of only one month are kept on one of these forms, so that a new sheet must be started on each job every month. Also, if a new molder is put on the job a new card must be made out as the cards are kept according to molder. They are folded to form a four page leaflet. On the front page, Fig. 11, the month and year are stamped, then the clock number, bench number and molder's name are written. Below are lines for the customer's name, pattern number, number of pieces ordered, number of pieces in a mold, piece price per mold, when to be made, weight of sprue per mold, weight of one casting, and general remarks.

The second and third pages, Fig. 10, contain three and two forms, respectively, for keeping a weekly record of castings. According to the method used by the company of dividing the year into 12 months of either exactly four or five weeks, the month always starts on a Monday. Thus, this year August beings on July 31 and ends on Sept. 2. The weekly forms are divided into columns for daily recording the molder's time; numbers of each, the pieces poured, good pieces, broken pieces, bad pieces and the floor loss; and the good weight. At the right hand side is a space for the balance due; for the weight of broken castings and the weight of bad castings; also for recording the bonus when one is due. At the bottom of each weekly form is a space for the number of pieces on a gate, number of good pieces, number of molds paid for, and the price per mold.

Summary Marked on Card

Besides the two weekly forms the card also contains a form for noting the summary of the month at the bottom of the third page, Fig. 10. This includes the number of pieces on a gate, weight of sprue and of casting, weight of castings and sprues, good castings, stock room defectives, net good castings, broken castings, bad castings, molding cost, core cost and special expense. The details of the special expense and core cost are kept on the fourth page of the molder's record card. The special expense includes expense for pattern, machine work, flask equipment, and miscellaneous expense.

One more form is used in connection with keeping track of the work; although this has nothing directly to do with the production department. This is the index card carried in the pattern storage, as shown in Fig. 9. On the top line of this card, the pattern number customer's name and the number of the shelf assigned to the pattern are marked. At the left is a column for marking the cores used on one casting and the coreboxes, whether of aluminum, brass, iron or wood. This is indicated by checking the word printed on the form. The next column is devoted to the name of the owner of the pattern and the molder's mark, and it also indicates whether the pattern is to be molded on a bench, on the floor, or on a machine. This latter is accomplished by crossing out the two names which do not apply, as shown in Fig. 8 which indicates bench molding. At the right of the card is a space for noting the date, price, number of pieces in a mold, whether the pattern is on a gate or a plate, how many pieces are on a gate or plate, and the material of which the pattern is made. The lower portion of the card is given to a column for a general description of the pattern, and three other columns are provided in which to note dates received and returned, and to whom the pattern is shipped.

As may have been noted, the key cards in this system are those shown in Fig. 4 and Figs. 10 and 11. The cards shown in Fig. 4 are kept in the production department in boxes. This provides a ready means for finding the state of the order, while the other cards give a full record of the work done and afford a means for determining costs.

The Iron Products Corp., New York, and its subsidiaries, the Central Foundry Co., Central Iron & Coal Co., Central Radiator Co., and Molby Boiler Co. have opened district sales offices in the Jefferson County bank building, Birmingham, Ala.

Adds Cerium to Brass and Iron

Effect on Red Brass Is To Increase Percentage of Leaky Castings and Lower Tensile Strength and Ductility—Shows a Marked Effect on Converter Steel and Causes Gray Iron To Feed Better

BY L. W. SPRING

CERIUM alloys, used in the experiments reported here were *misch* metal (mixed metal), said by executives of the Fansteel Products Co. from whom it was obtained, to contain around 60 per cent cerium and 25 per cent lanthanum, the remainder being almost entirely other metals of the cerium group. In one brass test a 10 per cent cerium copper alloy was used. The references to cerium throughout these data, therefore, include also the lanthanum and other cerium group metals which the mixed metal carried.

Experiments were made with it in the brass shop, in the cast iron foundry and in cast steel which at that time was being made by the side-blown-converter process. The converter now has been superseded by the basic electric furnace.

Cerium in Red Brass

Three tests of cerium in red brass were made and the results are shown in Table I. In each test both 1-inch brass valve body castings and test bars were made from a single pot of about 250 pounds of brass, part of which was poured into the molds without addition of cerium, and part of which was treated with the cerium deoxidizer. The valve castings were carefully inspected and tested for tightness under the usual 150-pound hydraulic pressure. The analyses and the physical tests obtained from the test bars poured at the time are also given.

In the first test three methods were tried:

(1)—One third of a 250-pound pot of red brass was poured off into a clean, hot graphite crucible and from this into molds, test bars and 1-inch gate valve bodies.

(2)—To the remaining two-thirds two ounces of mixed metal were added by means of a phosphorizer, the metal stirred and one-half of it poured into test bars and valve bodies. Calculated cerium was 0.075 per cent. Metal was as hot or hotter than in (1).

(3)—To the remaining third of the pot another ounce of cerium was added and similar molds poured as in (1) and (2). Calculated cerium was 0.15 per cent. The metal was a little cold.

There was a blue flame and some smoke when the two ounces of cerium were added but no violent reaction. The castings were normal in color. The fracture of those with cerium showed segregation and a gray rim. The fracture of those without cerium was normal.

Second Test

One ounce of cerium was thrown into the red hot crucible as one-third of a 250-pound pot of red brass was being poured into it. This metal was then poured into 1-inch valve bodies, test bars, etc. The remaining two-thirds, which, of course, contained no cerium, was poured into similar molds, those from the last five molds poured being taken for comparison with those poured from the cerium treated metal.

Third Test

Half a pot of red brass was poured into another heated crucible and then into molds. To the remaining half, 23 ounces of 10 per cent cerium copper alloy were added, the metal stirred well and poured. There was no dif-

Paper prepared for the convention of the American Foundrymen's association held in Rochester, N. Y., June 5 to 9.

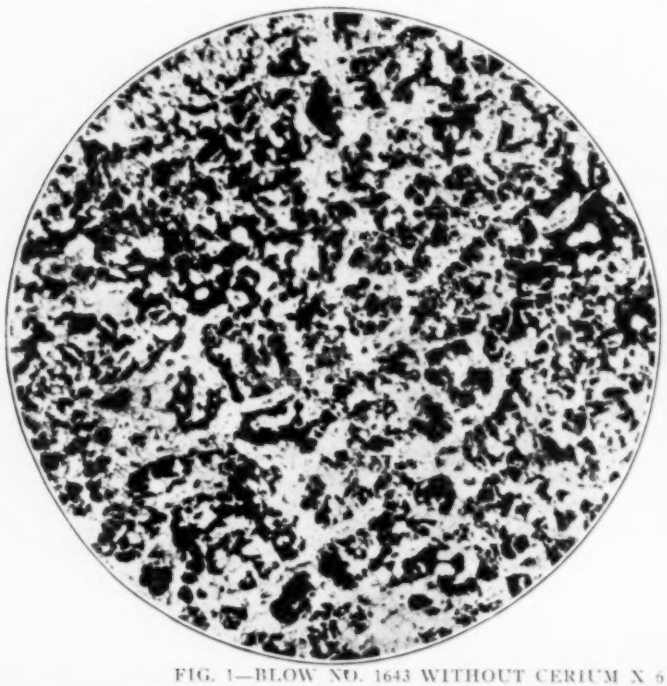


FIG. 1—BLOW NO. 1643 WITHOUT CERIUM X 65

FIG. 2—BLOW NO. 1643 WITH CERIUM X 65

Fig. 1—Analysis: Silicon, 0.30; manganese, 0.70; sulphur, 0.081; phosphorus, 0.059; combined carbon, 0.36 per cent. Tensile strength, 81,750; yield point, 44,500; elongation in 2 inches, 18 per cent; reduction of area, 24.1 per cent. Fig. 2—Analysis: Silicon, 0.32; manganese, 0.71; sulphur, 0.027; phosphorus, 0.051; combined carbon, 0.36 per cent. Tensile strength, 77,800; yield point, 35,300; elongation in 2 inches, 26 per cent; reduction of area, 42.1 per cent.

ference in the appearance of the molten brass with and without cerium copper.

The fractures of the valve bodies without cerium were uniform and normal. The fractures of the valve bodies treated with cerium were segregated with gray rims. The leaky bodies with cerium, when broken through the leaky spots, showed very spongy metal and some inclusions.

Cerium Fails in Tests

These tests show that the percentage of castings which leak rises with addition of cerium and the tensile strength and ductility of the metal decreases. Therefore, as a deoxidizer for leaded brasses, cerium has no value, as it causes segregation and spongy, leaky castings. Tests were made on brasses and bronzes without lead, as for these, or at least for the copper-zinc alloys such as the manganese bronzes, aluminum is an efficient and much less costly deoxidizer. It is well known that aluminum cannot be used in alloys that contain lead and it appears and seemingly has been proved by these tests that cerium has a similar action with lead. It is stated by others who have tried cerium in brass that the inclusions noted in leaded brasses are cerium lead alloys.

Tests on Cast Iron

Tests were made with cast iron. From the same ladles of soft cast iron from the cupola, test bars and some 2½-inch cast iron tees were poured, part without and part with cerium calculated to give sufficient of the cerium metals to considerably reduce the sulphur and phosphorus content as the claim had been made that cerium acted upon phosphorus and sulphur in the irons and steels.

In the two tests made with gray iron the cerium was thrown into the shank ladle as the iron was being poured in from the bull ladle. The reaction was not violent. The iron was well stirred before pouring. The metal was fluid but considerable slag came to the top of the ladle. The molds poured with cerium showed much greater shrinkage in the gate, i.e., the iron apparently fed better. Results of these tests are shown in Table II.

Converter Cast Steel

Additions of one pound of the cerium alloy were made to 100 pounds of converter cast steel of four heats. With the steel tests a difficulty was that the necessity for particularly hot metal for the small castings necessitated the pouring of small quantities of steel rather quickly after addition of the deoxidizers in order to avoid too great cooling of the metal. No castings were poured for test, regular physcial test bars and samples for chemical analyses, only, being taken.

The mixed metal was tossed into the stream of steel as it was being poured into a hand ladle. Test bars with and without cerium were poured and from each blow. The reaction of steel and cerium was not violent. The steel with cerium seemed to stay alive and *worked* longer than that without. A white slag formed on top of the steel in the ladle and some came to the tops of the risers after the steel was poured. Excessive shrinkage took place in the risers. The steel was fluid. The results are shown in Table III.

The first two converter blows tried, Nos. 1565 and 1598, gave rather erratic results in the physical tests. Blows Nos. 1643 and 1846, however, show that cerium has an important effect upon steel, increasing the elongation and reduction of area and reducing the sulphur without affecting the percentages of any other metalloid.

The results are as follows:

Heat No.	1565	1598	1643	1826
Sulphur before addition	0.086	0.088	0.081	0.084
Sulphur after addition	0.043	0.036	0.027	0.041
Loss of sulphur	0.043	0.052	0.054	0.043
Per cent removed	48.8	59.1	66.7	51.2

All of the test bars were annealed in the laboratory from six to eight

Table I

Effect of Cerium Additions to Brass

FIRST TEST

	Amount mixed metal added	Per cent cerium	Sn.	Pb.	Cu.	Fe.	Zn.
1	None	0.000	6.13	2.36	81.55	0.27	9.59
2	2 oz. to 166 lbs.	0.075	6.15	2.85	82.52	0.20	8.49
3	1 oz. to 83 lbs.	0.150	6.27	2.66	82.00	0.20	8.50

	Valve bodies poured	Leakers per cent above normal	Tensile strength	Yield point	Per cent elong. in 2 in.	Fracture
1	30	Normal	38,300	20,800	20.0	O.K.
2	24	58	32,100	20,700	12.5	Seg. gray rim
3	24	63	29,800	22,100	9.5	Seg. gray rim

SECOND TEST

	Amount mixed metal added	Per cent cerium	Sn.	Pb.	Cu.	Fe.	Zn.
1	None	0.000	5.07	1.65	84.26	0.27	8.33
2	1 oz. to 83 lbs.	0.075	5.26	1.92	84.28	0.25	8.24

	Valve bodies poured	Leakers per cent above normal	Tensile strength	Yield point	Per cent elong. in 2 in.	Fracture
1	29	Normal	35,600	21,400	20.5	O.K.
2	24	51.3	33,050	20,875	15.5	Seg. gray rim

THIRD TEST

Amount alloy added	Per cent cerium added	Valve bodies poured	Leakers, per cent above normal	Fe.	Tensile strength	Yield point	Per cent elong. in 2 in.	Fracture
None	0.000	63	Normal	0.06	{ 35000 { 33400	21400 21500	18.0 14.0	O.K. O.K.
23 oz. 10 per cent Ce Cu to 125 lbs.	0.115	63	72.8	0.06	{ 30400 { 28450	19950 19820	14.0 10.5	Flaw Seg. Flaw Seg.

Table II

Effect of Cerium Additions to Iron

FIRST TEST

	Mixed metal addition	Per cent cerium	Si.	Mn.	Sul.	Phos.	Gr. C.	C.C.
1.	None	0.00	2.44	0.51	0.127	0.81	3.30	0.10
2.	½ lb. to 100 lbs.	0.50	2.44	0.41	0.111	0.79	3.24	0.10

SECOND TEST

3.	None	0.00	2.44	0.53	0.115	0.76	3.30	0.10
4.	½ lb. to 100 lbs.	0.50	2.54	0.60	0.104	0.75	3.30	0.10

	Tensile strength	Transverse strength	Deflection	Brinell hardness	Shrinkage	Leakers, per cent above normal
1.	23060	2775	.10	187	.115	Normal
2.	26760	2935	.13	175	.113	Normal
3.	{ 24960 { 24960	2870	.11	150	Not det.	Normal
4.	{ 27570 { 26300	2980	.12	150	.119	Normal

SUMMARY

Test	Reduction of sulphur Per cent	Increase in tensile strength Lbs. Per cent	Increase in transverse strength Lbs. Per cent	Increase in deflection Per cent
First	.026 = 20	3700 = 13.6	160 = 5.8	.03 = 30
Second	.011 = 10	1975 = 7.9	110 = 3.8	.01 = 9

TABLE III

Results of Tests on Converter Steel

Converter blow	Cerium pounds	Added per cent	Amount found	Si.	Mn.	Sul.	Phos.	C.C.	Tensile strength	Yield point	Per cent Elon. in 2 in.	Per cent Reduction of area	Fracture
1565	None	0	0	.42	.84	.086	.054	.37	90250	51900	22.0	31.2	Fibrous
	½ to 100.	.5	.16*	.42	.82	.043	.056	.41	98050	51250	20.0	24.5	Fibrous
									68500	47500	4.0	17.1	Dirty brown and gray
1598	None	0	0	.32	.75	.088	.056	.40	89000	46500	20.0	25.8	Fibrous
									90400	50500	20.5	23.4	Gran.
	1 to 100..	1	Not det.	.32	.79	.036	.051	.39	91100	46550	21.0	32.0	
									83250	49500	7.0	....	Broke in shoulder—dirty
1643	None	0	0	.30	.70	.081	.057	.36	81750	44500	18.0	24.1	Gray Fir-tree
	1 to 100..	1	.44*	.32	.71	.027	.051	.36	77800	35300	26.0	42.1	Fibrous
1826	None	0	0	.32	.73	.084	.063	.37	85050	49750	21.0	25.9	Gray Fir-tree
	1 to 100..	1	Not det.	.33	.72	.041	.063	.36	97250	53600	25.0	32.2	Gray Fibrous

*Determinations made by United States bureau of mines.

hours at 1700 degrees Fahr. and cooled in the furnace, which was the regular works practice for steel castings. The low results of the last bars tested from blows Nos. 1565 and 1598 were due to the rusty colored inclusion, probably an oxide, from which the metal did not free itself. This was not the case with the other bars, which were clean. During the testing of one or two of the bars a faint odor which we thought was acetylene was given off. Such an odor has also been remarked by H. W. Gillett, of the United States bureau of mines, who has recently made investigations.

The test blocks on blow No. 1598, on the under side of which the bars were cast, were sawed in half. The shrink cavity of the cerium steel bar was approximately of the same size as that in the regular steel bar from the same blow not treated with cerium.

A particularly noticeable effect was the appearance under the microscope of the steel treated with cerium. Fig. 1 shows the steel of blow No. 1643 without cerium. This shows what is known as *ingotism*, a nonuniform structure caused by the crystallizing of the ferrite (white) areas in *strings* around the small inclusions, consisting of more or less emulsified manganese sulphide, oxides, slag, etc., which serve as nuclei. These inclusions do not appear in the steels after treatment with one per cent of cerium, as is shown in Fig. 2, the manganese sulphides, oxides, etc. having been removed by the cerium so that the steel is really much cleaner. This is an end which is desirable in steelmaking. Steel which is clean and of such uniform structure as that shown in Fig. 2 has much more ductility than steel which carries oxides and emulsified slag. The lowered sulphur accounts for much of this, ingotism once formed being extremely difficult to break down, higher temperatures and more drastic annealing being necessary.

Advance Made in Die Casting Methods

BY A. M. BREWSTER

ALMOST a century ago castings were produced by pouring molten metal by gravity into iron molds and by means of crude leverage contrivance bringing pressure on the metal before it became frozen. Later, about 1840, machines were built in this country for the purpose of casting type. Even earlier than this, before the war with Mexico, crude machines were devised to manufacture bullets. From the slight knowledge gained from the typecasting machine, the die-casting industry has gradually developed. The first machines to produce die castings successfully were known as the plunger type. Dies were closed and opened by means of a toggle device, this being the only known method of keeping the dies firmly closed. The molten metal was then forced into the dies by means of a piston working inside a cylinder. Each machine required three operators. One can readily understand that castings thus produced, while possibly having a smooth surface and being more or less close in respect to limits in dimensions, could not have a high tensile strength; also that a generous amount of porosity would be present, sufficient pressure to solidify the metal being absent. This type machine is still in use in some plants.

Other types have belt driven machines which, by the use of gears and cams, operate the dies back and forth. Steam is also applied to cylinders for this purpose. It functions a piston which in turn is integral with one of the die blocks. However, this is a considerable hardship on machine operators, due to the excessive heat. Some machines operate vertically by use of steam cylinders. The dies being raised (opened), the machine swings back into horizontal position by means of hinges and counterweights. In this case the dies are directly above the molten metal pot. The units on some machines are operated by a single operator who controls all functions.

Die castings may be described as alloy castings, produced under pressure other than gravity in a metallic mold or die. I emphasize this fact because this process is apt to become confused with that of the permanent mold process.

In many cases the use of die castings is not appreciated, the manufacturers, especially those equipped with their own foundry, still continue to sand cast, snag and tumble, then drill, ream, broach, mill, jig, thread and, in general, put the part through many machining operations. This expense could be partially, and often entirely, eliminated by the use of die castings. Die-cast parts are shipped direct to users, ready for assembly, excepting where 0.0005 inch limits are specified, but even here the total machining cost is practically negligible. While the steel die acts as a gage, unless one has complete control of the alloy as to temperature, etc., castings will vary from the same die. Therefore, to hold castings accurate, shrinkages must at all times be known and under positive control.

Although alloys of aluminum are comparatively new in die-cast form, still today a greater portion of parts are die cast of aluminum than of all

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other alloys. Aluminum is alloyed with manganese, copper, nickel and zinc, to produce the best die castings. Pure aluminum has too great a shrinkage, is too soft, has too coarse a grain, and does not have the desired strength to fit it for die castings. The tensile strength increases with the percentage of copper. It is further increased about 12 per cent by quenching the hot casting in water. Today alloys produced commercially average 16,000 to 22,000 pounds per square inch tensile strength.

Aluminum alloy castings having 28,000 pounds per square inch tensile strength, and at the same time showing high ductility, are made by the use of alloying metals other than copper.

The purity of zinc used in alloys for die castings is highly important. To obtain desired results, it must be alloyed with tin, copper and aluminum. Zinc-alloy die castings are being produced which show a tensile stength of 40,000 pounds per square inch. Alloys of zinc are affected by the atmosphere and weaken in time. However, by the application of coatings such as plating, enameling, etc., zinc alloy castings have been enabled to retain their strength after ten years of use. It might be said that any form of plating desired now can be applied to these alloys. Also, disintegration of these alloys can be eliminated.

Lead alloyed with antimony is employed extensively in die casting parts of storage batteries such as grids, posts, straps etc., also for parts of mechanical toys, and is used widely for the manufacture of plumbing supplies. This alloy, though not as strong, is cheaper than the zinc alloys.

Tin Shrinkage Low

Alloys of tin with copper, lead, and antimony, produce parts where delicacy is required, the shrinkage of tin being low. These alloys are used extensively in electrical devices, dental and surgical instruments, soda fountain equipment, and also in bearings.

A high grade steel for dies has not been obtainable until the past four or five years since alloy steels have been developed, together with proper methods for heat treating them. The toughness given the die by heat treatment enables it to withstand the continuous heat shock of the molten metal at from 900 to 1250 degrees Fahr. The use of water jackets around all dies is essential to prevent them from excessive temperature. If the steel is not heat treated the dies will produce only a few thousand castings before small surface cracks appear. These, even if ground out, will continue and eat their way into the solid steel die to a depth of ¼ inch or more. Those cracks while not materially affecting the strength of the casting, produce an irregular surface on the product, and if it must be polished, greatly increases the cost of this operation. With proper treatment of the dies, 35,000 or more castings can be made in it.

All machine operations are not eliminated by die castings. Some concerns allow tolerances of plus 0.0 and minus 0.0005 inch, others plus or minus 0.0005 inch and even less. When these limits are necessary, there should be 0.002 to 0.004 inch stock left for machining. A good commercial tolerance to be allowed on parts desired to be die cast without subsequent machining is plus or minus 0.0015 inch to the running inch. It is possible but not commercially practicable to hold to closer limits. The tolerances for alloys of aluminum should be greater than those for zinc, tin, or lead alloys, due to the greater volume change of freezing aluminum.

How and Why in Brass Founding

By Charles Vickers

Care Required to Make Air Tight Metal

We should like to obtain a mixture for air-tight metals. We have been using the two following mixtures for casting heads for acetylene torches, but they do not prove air tight. (1) *Copper,* 80 *per cent; tin,* 8 *per cent; phosphor tin,* 2 *per cent; lead,* 10 *per cent.* (2) *Copper,* 85 *per cent; tin,* 5 *per cent; Zinc,* 5 *per cent; lead,* 5 *per cent.*

Can you suggest mixtures that would be more suitable?

The following alloys can be tried; they have a good reputation for use in castings intended to withstand air pressures and were presented in a paper by S. D. Sleeth, read before the Institute of Metals (American) a few years ago. The first alloy, the least costly can be tested first after which in case it fails, use the second alloy.

Alloy No. 1.

	Pounds
Copper	82.00
Tin	7.50
Zinc	4.75
Lead	5.75

Alloy No. 2.

	Pounds
Copper	83.00
Tin	11.50
Zinc	4.00
Lead	1.50

To quote Mr. Sleeth: One of the important matters is melting; the alloys must never be allowed to *soak* in the furnace, but must be removed the minute they are ready: also aluminum must be rigidly excluded. All stocks of this white metal should be headed up in barrels and then rolled outside and the shop floor swept clean of every bit of dust that might harbor aluminum, before the work of making air-tight castings is commenced. There will be some hope of success, provided the fuel is low in sulphur; the metal unburned and poured at the correct temperature. About one ounce of phosphor copper to the hundred pounds metal is the maximum to use; it should be put in the bottom of the crucible with the cold copper, and covered with charcoal before it is melted.

Make Heavy Pinions in Dry Sand Molds

We should like to obtain the formula for a good bronze suitable for heavy pinions. We use 10 *per cent phosphor copper and melt in barrel-type oil-fired furnaces*

The following phosphor bronze makes an excellent alloy for pinions and worm gearing and is extensively used for those types of castings.

	Pounds
Copper	86.00
10 per cent Phosphor copper	3.00
Tin	11.00

The alloy for some reason with which we are not familiar is known as Stone's English Gear Bronze and when the phosphorus content is fixed at 0.3 per cent, the alloy machines better than when it is higher. It will be well to make heavy pinions in dry sand molds, and to coat the molds while green with a creamy wash of plumbago, mixed with molasses water, which will prevent the metal cutting into the sand. Also coat the cores with plumbago, wiped on in the

form of paste, with the fingers and afterward polished and dried.

Holes Appear in Bushing at Gate Junction

Small gas or air holes sometimes appear at the point where the gate has been cut from our bushing castings. A peculiar feature in connection with these holes is that they only appear at this one place, the remainder of the casting machines up as clean as a bell. Perfect and imperfect castings were made from the same metal mixture, therefore we blamed the cores. We changed the core binder, but it did not effect the castings, in fact we have found holes in castings that were cast solid, that is without cores. We use copper 85 per cent; tin 10 per cent; zinc 3 per cent; lead 2 per cent. We have added 0.5 per cent phosphor copper, but the effect was to harden the castings and render them more difficult to machine.

The fact that the castings are sound all over except at the gate inclines us to the opinion that the method of gating may be at fault. A slight change may be all that is necessary. We suggest a study of the gates with a view of determining whether or not there is a possibility of the runner draining metal from the casting. Water has to be forced up hill and liquid metal acts exactly like water. Metal entering a mold at the joint has to be forced up hill to fill any part of the mold extending into the cope. The pressure is furnished by the column of metal filling the runner basin and sprue. If the sprue is small in section it will set before the casting and with the pressure removed the still liquid casting will back into the runner through the gate leaving a small hole at that point. Where the metal is poured a little on the cold side the shrinks will show up. We suggest a study of the gates, keeping in mind the relative sizes of the castings, sprue and gates, for while some really wonderful work has been done using *pencil gates* and tiny runners and sprues, as a general rule it is better to err on the side of too much feeding. It is more economical to melt a little extra metal the first time than to make castings over.

Suggests Mixtures for Aluminum Solder

In making aluminum solder difficulty has been experienced in getting a good melt. The formula we used follows: Tin, 61.60 per cent; zinc, 25 per cent; aluminum, 2.20 per cent; phosphorus, 11.20.

The phosphorus was added as phosphor tin after all the other metals had been melted, but when a small addition of phosphor tin had been made, we found that an additional amount caused the metals to harden and separate, forming a soft, spongy, porous mass. We shall be glad of any suggestions you may be able to offer.

It is impossible to make an alloy having the formula given as the components are entirely out of proportion. The phosphorus is entirely too high, and we are inclined to think that in some way the figures have been mixed. Even if the aluminum and phosphorus are changed to read aluminum 11.20, phosphorus 2.20, then the phosphorus still will be several times higher than it should be. The following alloy would be better;

ALUMINUM SOLDER

	Per cent
Tin	81.00
5% phosphor tin	5.00
Zinc	9.00
Aluminum	5.00
	100.00

This formula is one suggested by the United States bureau of standards.

Effect of Glass on Crucible Questioned

For the past year or so we have been using window glass as a flux in melting red brass which we use exclusively for the castings we are making. We have had poor results from our crucibles, which are Nos. 60 and 70. As we take particular pains in our treatment of the pots, and have been unable to account for our lack of success, it occurs to us that possibly the glass might have something to do with the shortness of their life. Can you throw any light on the subject? We have been advised by a flux manufacturer that the glass would do this.

It is easy to determine if the use of glass as a flux is shortening the life of the crucibles. When a flux that attacks a crucible is being used, the inside of the pots will be clean, the graphite will be exposed and the pot will get thinner from the inside; also the slag that is the top of the metal and oxide, the glass is not attacking the pot. Window glass is a silicate of soda and of lime and is not likely to attack crucibles when used as a flux. In fact, it is not a flux, but simply a covering for the metal, which protects it from furnace gases. The objection to glass is usually based on its stickiness which renders it more difficult to skim the dirt off. This can be remedied by throwing sand or lime on the surface just before skimming.

As far as the glass is concerned it is difficult to see how it can shorten the life of the crucibles. In order to decide the point it would be necessary to have more evidence as to the condition of the pots when they fail. Such fluxes as soda ash will shorten the life of pots because the alkali attacks the silica in the pot in order to form a glass therewith. This question is one that should be given careful consideration before it can be answered positively. It is easy to blame the use of glass, when other factors enter into the problem.

Alloys for White Brass and German Silver

We should like to learn how the alloy known as White brass is made, and also we would like to get the formula for a cheap alloy of German silver.

White brass is an alloy of zinc, tin, and a little copper, with sometimes antimony. Sometimes the copper is omitted altogether as in the following alloy, which makes a good, ordinary white brass:

White Brass

	Per cent
Tin	60.00
Zinc	38.00
Antimony	2.00

German Silver

	Per cent
Copper	50.00
Zinc	35.00
Nickel	15.00

Flux with 2 ounces of aluminum, added to the molten copper and nickel, before zinc addition is made.

Formulas for Babbit and Aluminum Solder

We would be pleased if you would favor us with the formula of genuine babbitt, and also a formula for a good aluminum solder.

To make what is called *genuine babbitt* use the following mixture.

GENUINE BABBITT

	Per cent
Tin	89.00
Antimony	7.50
Copper	3.50

A convenient way of making it is to first prepare a hardener as follows:

HARDENER FOR BABBITT

	Per cent
Copper	17.50
Antimony	37.50
Tin	45.00
	100.00

Use the hardener in the proportion of 20 pounds to 80 pounds of tin, melt the tin and hardener together, and mix by stirring. The following is used as an aluminum solder:

ALUMINUM SOLDER

	Per cent
Zinc	25.00
Tin	69.00
Aluminum	6.00

Plead to Briton's Indictments

American Experts Offer Pertinent Comment Upon Points Raised in Exchange Paper from the Institution of British Foundrymen on Gray Iron Quality—Common Ground Sought

MUCH comment has been aroused by the exchange paper presented at the Rochester convention of the American Foundrymen's association by F. J. Cook, representing the Institution of British Foundrymen. The session which featured this paper was marked by the most lively verbal and written discussion in which the controversial element was absent, and a real desire to come together upon a common ground was evident. Unfortunately the time available did not permit a more extended development of some of the points. Many of the discussions from the floor picked upon some of the generalties in Mr. Cook's paper and failed satisfactorily to meet the main contention of the author that British iron, made under normal conditions from a mixture of pig iron and gray iron scrap possesses a tensile strength nearly twice as high as the average American iron made from parallel constituents. Mr. Cook's paper was presented in the June 15 issue of THE FOUNDRY, and three formal discussions submitted by representative American foundrymen follow. Other worthwhile observations doubtless will be offered

Domestic Iron Meets Standards Set

BY GEORGE K. ELLIOTT

AS AN international paper Mr. Cook's discussion is admirable because of the insight it gives Americans into important points of British gray-iron metallurgy, and because of its attractive controversial possibilities. The paper cannot help but redound to the great good of gray-iron theory and practice in both Great Britain and the United States.

There are two kinds of iron castings: those made from appropriate iron especially formulated for the particular casting; and those made from common nondescript cast iron, which, while broadly useful is not generally a felicitous choice for particular requirements. We suspect that Mr. Cook is comparing, in parts of his paper, British iron of the first class with American iron of the second. If our British friends have found some American machine tool castings faulty, it is possible that they belonged to the last class; especially would this be true if casting in question were made under stress of war conditions when some manufacturers found their own foundries too small and were forced to let out a part of their castings with a lack of discrimination that often was unavoidable. In this country, as in England, it is probable that machinery builders who make their own castings have the iron under intelligent control producing castings equal in every way to the demands of the intended service. I am a persistent advocate of specialization in foundry irons and therefore hail this part of Mr. Cook's paper with special satisfaction because it adds emphasis to a point all too little realized in some engineering circles. There is far too much needless obloquy attached to cast iron simply because a few manufacturers either through ignorance or carelessness are habitually allowing questionable grades of iron to enter into important castings.

Mr. Cook mentions the reported failures of cast iron parts in America under exposure to superheated steam. This phenomenon of growth and warping under superheated steam has been referred to by American writers with more frequency and emphasis than are justified by the instances of its occurrence. A search of technical literature shows that the most of the references go back either directly or indirectly to three papers read before the American Society of Mechanical Engineers over 12 years ago. The number of cases reported since then is small. Those mentioned are not to be denied, but my long experience in this line convinces me that when fittings intended to handle superheated steam are made from appropriate iron the danger of failure is remote except possibly where most uncommonly high degrees of superheat are used. I have yet to see the first valve or fitting made of suitable iron that has failed under this service. It is certain that cast iron parts made by American manufacturers specializing in this line and making their own castings, are made of iron entirely capable of encountering successfully the feared, but somewhat overestimated, superheat peril.

The average of over 36,000 pounds per square inch tensile strength attained by Mr. Cook bespeaks the sterling foundryman and suggests that his iron falls within the category of special irons; at least it would be unfair to set it up against iron of the common variety. Quite interesting in this same connection would be a record of strengths of iron melted in the average English jobbing foundry. I myself have seen many hundreds of heats of iron run without the aid of steel additions, having an average tensile strength corresponding almost identically with that obtained by Mr. Cook. However, this iron, was made for a particular purpose and should not be compared seriously with the product of the ordinary foundry catering to the ordinary trade. Mr. Cook's tensile and *arbitration* strengths in Table 1 are highly commendable, but should not reflect unfavorably upon American iron because his bars were cast on the main castings while the arbitration bars were cast separately. It is well known among foundrymen that test bars can be located so favorably in relation to the main casting, when *cast on*, as to give great advantage to the bars even

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to the extent of giving a grossly exaggerated indication of the true strength of the iron in the main casting.

The attempt to reconcile the strength of the 1¼ inch round American arbitration bar with that of British 1-inch square bars by use of the factor 0.74 is not to be commended because no account seems to be taken of the quite different manner in which square and round section bars form crystals while cooling. Mr. Cook used this same device in his able and keen discussion of my exchange paper before the Institution of British Foundrymen last year which is referred to by him in the preprint of the present paper where he calls attention to the fact that his lowest "equivalent load" (evidently obtained through the 0.74 factor) was higher than the transverse strength of electric furnace refined iron mentioned in my paper. Mr. Cook seems to take it for granted that the strengths mentioned in my paper were exceptional for American iron. This was far from being the case; they were not given as being the last word in cast-iron, test-bar strengths, but rather as illustrations of the improvement wrought in irons of somewhat lowly origin by treatment in the basic-hearth electric furnace. The strengths were shown in pairs so as to depict the same iron before and after treatment, and so doing fulfilled their only mission of showing that the process materially improved the original cupola metal. That the strengths were in any way exceptional was not claimed. Purposely did I avoid injecting the phenomenal into the paper which fact does not seem to have been understood by several British commentators.

In the case of carbon in cast iron, I am sure it will be found that more iron foundries in this country pay attention to it than Mr. Cook suspects. These naturally do not include the great rank and file of unspecialized foundries already mentioned, but only such as make the better grades of castings. In making fittings for superheated steam for instance certain foundries pay great attention to the amount, the size and the distribution of the free carbon.

Sulphur Debatable

The sulphur question is taken up in the paper and it is safe to assume that this is one question that never will be settled to the satisfaction of everybody, especially of persons who through geography or economy are somewhat inescapably tied fast to high sulphur. To a less extent this is also true of phosphorus in considering which Mr. Cook makes the important observation that its distribution is of utmost importance, that segregated phosphide is more dangerous than the uniformly distributed. It is my belief that high phosphorus and high sulphur will become less dangerous only when foundrymen learn a way to produce without fail, both phosphides and sulphides in a certain *optimum* degree of dispersion and of a certain critical particle size. I do not believe that foundrymen have yet learned the way to do this, but discussions such as Mr. Cook's will aid greatly in throwing the desired light upon the subject. As matters now stand it seems that sulphur and phosphorus are safest when absent.

I am much pleased to see Mr. Cook refer to tests of a more dynamic nature than the usual tensile and transverse tests. It is to be hoped that a more general adoption of dynamic or shock tests is near at hand for I believe these tests will greatly increase our knowledge of the differences between irons now apparently the same as far as the usual static tests go and yet which do not show up the same in service. I have in mind two sets of valve body castings weighing about 600 pounds each that were broken up under a foundry drop-weight. One set was made from iron having about 0.08 per cent sulphur and an average of two drops of the weight were necessary to break each casting. The other set was made of the same iron but refined in the electric furnace, with sulphur at about 0.035 per cent. These castings required four or five drops each for breaking. By transverse tests the second iron was about 35 per cent stronger than the first; by the drop test it was over 100 per cent stronger than the first.

The theory advanced in the paper and attributed to J. E. Fletcher, concerning the relative effects of hot and cold blast furnaces upon the structure and properties of gray iron, is by way of contrast, strongly suggestive of the thought advanced by the late J. E. Johnson in his theory of oxygenated iron. Johnson's theory is that the cool running charcoal blast furnace causes a certain marked oxygenation of the iron which condition in turn, he contended, effects a compactness of the graphite formation that is not to be found in the product of the hotter running coke-blast furnaces. On the other hand, Mr. Cook bases his claims for superiority in the iron from the cool running furnace, upon a quite different assumption—that through *lack* of oxidizing conditions a certain boundry-intercohesional strength is preserved in the metal. Therefore, we are now confronted with two theories, both touching upon the question of oxygen and both claiming excellent properties in iron made in cool running blast furnaces. However, one attributes the superiority to oxygen picked up under the named conditions while the other declares the iron to be superior because the same given conditions are not favorable to taking up and retaining of oxygen. Both theories touch upon fundamentals of the greatest interest, but neither is convincing and we feel justified in demanding more and better evidence.

Cites High Grade Engine Castings

BY R. S. McPHERRON

IN HIS excellent paper, Mr. Cook has advanced a number of original and unique ideas. It is a great pleasure to note his development of the metallography of cast iron, which is as complex as that of steel and has not received sufficient attention. If it were possible, we would be glad to examine one of their specimens of cast iron to see just what he means by the distribution of phosphorus. Some of us have always believed that phosphorus to the extent of 1 per cent has an unfavorable action on the physical properties of cast iron.

It is unfortunate that Mr. Cook limits his comparison of physical properties to irons made without the addition of steel in the cupola. This is a common practice in American foundries and is the method by which we usually make our high test irons. He cannot mean to criticize our material and then exclude from consideration or comparison our best grade.

We note that he quotes from only one grade of cast iron. It would be interesting to know if the British use the same grade for all castings.

Mr. Cook's comments on transverse and tensile strength show extremely good results, probably better than many foundries in this country would

Mr. McPherron is metallurgist for the Allis-Chalmers Mfg. Co., Milwaukee.

show. It is difficult to compare tests on transverse bars of various sizes. Our practice is to use a bar 1 x 2 x 24 inches between supports, broken with flat side down and loaded in center. In the last three months, we have tested 55 sets of such bars for an inspected job, with average transverse load of 3055 pounds and the deflection of 0.54 inches.

On one recent order, the 82 sets of tensile bars cast for the job averaged 32,700 pounds per square inch. On another similar order, the 85 sets of tensile bars averaged 33,670 pounds per square inch. All our bars are cast in separate molds and the tensile bars are cast 1⅛-inch round by 14 inches long. The ends are rough machined and middle of bar turned to about 1 inch in diameter for a space of about 2 inches.

The above bars represent all the tests made and were not selected for their high value. They represent our medium grade material and not our hardest grade material from which we make our cylinders, liners, etc. Transverse bars of this latter mixture (1 x 2 x 24-inches as above) have gone as high as 4280 pounds. This would be considerably over 40,000 pounds per square inch in a tensile bar.

Two tensile bars recently cut from the bore of a liner for our 48-inch diameter gas engine cylinders broke at 36,080 and 36,480 pounds per square inch. This liner weighed about 5000 pounds in the rough with a metal thickness of about 1½ inches. The brinell hardness of the casting was 183 taken on finished bore.

Another bar just cut from a full sized prolongation of a 44-inch diameter gas engine liner showed 37,960 pounds per square inch. The hardness of bore after machining was 192. This casting weighed 4300 pounds in the rough with metal thickness of nearly 1½ inches. These tensile bars were turned to 0.25-inch diameter with threaded ends. In view of their being cut from a large casting, we feel these tests represent as good material as any to which Mr. Cook refers.

While we have made tests of our Class "A" iron showing over 40,000 pounds to the square inch, we do not make many tensile test bars for castings made from this mixture. The test bars are apt to be mottled and extremely difficult to machine. In place of so many tensile bars, we now are making more hardness tests on the finished castings. It might be noted in this connection, that the length of wear of cylinders or liners is not determined by their tensile strength, but by their hardness and closeness of grain. Another reason why the tensile test bar is not more used in this country is that the cost is over twice that of a transverse bar.

We would be inclined to agree with Dr. Moldenke in his statement that the average testing machines in this country do not pull absolutely in line, which naturally reduces the reported tensile strength.

The question of fillets is of extreme importance. Some time ago, one of the American Society for Testing Materials committees on cast iron, found that by making the fillet on our standard cast iron test bar much easier, the tensile strength could be increased by an average of over 3000 pounds to the square inch. This change, I believe, will soon be officially adopted.

No doubt exists that many of our American castings are too soft. On this point, I believe we are open to criticism. Too much attention is given to ease of machining. However, this has been done purposely, and not because it was impossible to furnish close grained and strong material.

In regard to breakage of American made fly wheels, I wish to quote our power department as follows:

"The practice of the Allis Chalmers Mfg. Co is to run cast-iron fly wheels for engines up to a peripheral speed of 6000 feet per minute. During the past 45 years, we have built more than 7000 engines, aggregating over 6,000,000 horsepower. During this period, we have had only two or three reported fly wheel failures which in each instance were directly traceable to overspeeding due to some breakage or failure of the governing devices.

In our saw mill practice, the standard peripheral speed of cast-iron band saw wheels is 10,000 feet per minute with occasional speeds of 11,000 feet per minute. None of the several hundred wheels of this type built within the past 20 years have failed in service and but one or two, after periods of 15 to 17 years' service have required replacement due to local conditions. Outside of the experience of the Allis Chalmers Co .it would appear that fly wheel failures in America have not as a rule been due to the quality of the material, but either to overspeeding due to failure of the engine governors or to bad design of the wheels themselves."

We are greatly interested in Mr. Cook's statement or question as to whether a slower running of the blast furnace and also lower blast temperatures would not tend to increase the strength of the castings made from resulting pig iron. It is common belief that warm-blast, charcoal, pig iron is not as strong or as good as cold blast and it is quite possible that warm blast coke iron might be of better quality than a hot blast iron.

In referring to Mr. Cook's belief that the American practice is to regulate the mixture entirely by silicon content, with no reference to total carbon, would say that this can hardly be the case, as a large percentage of American foundries purposely reduce the total carbon by adding steel in the cupola, which apparently is not the English practice.

We are inclined to agree with what Mr. Cook says about the influence of sulphur. The influence of this element in times past, has been much overemphasized. However, the specifications of the American Society for Testing Materials allow sulphur up to 0.12 which is considerably in excess of 0.07 as desired by Mr. Elliott. I have seen any number of good iron castings, containing from 0.15 to 0.18 sulphur. As Mr. Cook says, manganese in these castings should be fairly high.

Inexperience Blamed for Iron Quality

BY STEPHEN B. PHELPS

THE paper by F. J. Cook contains statements that American foundrymen and engineers know to be incorrect if it is inferred that the inferior castings cited represent standard American practice.

Mr. Phelps is connected with Jones & Laughlin Steel Co., Pittsburgh.

The statement is made that large quantities of machine tools sent over to England during the war had poor wearing qualities and that it was said that the cast iron was so soft as to be easily cut by a pocket knife. Certainly castings of the grade mentioned were not made in foundries which customarily supply the machine tool trade, and they must have been made by foundries unfamiliar with the requirements of machine tool parts.

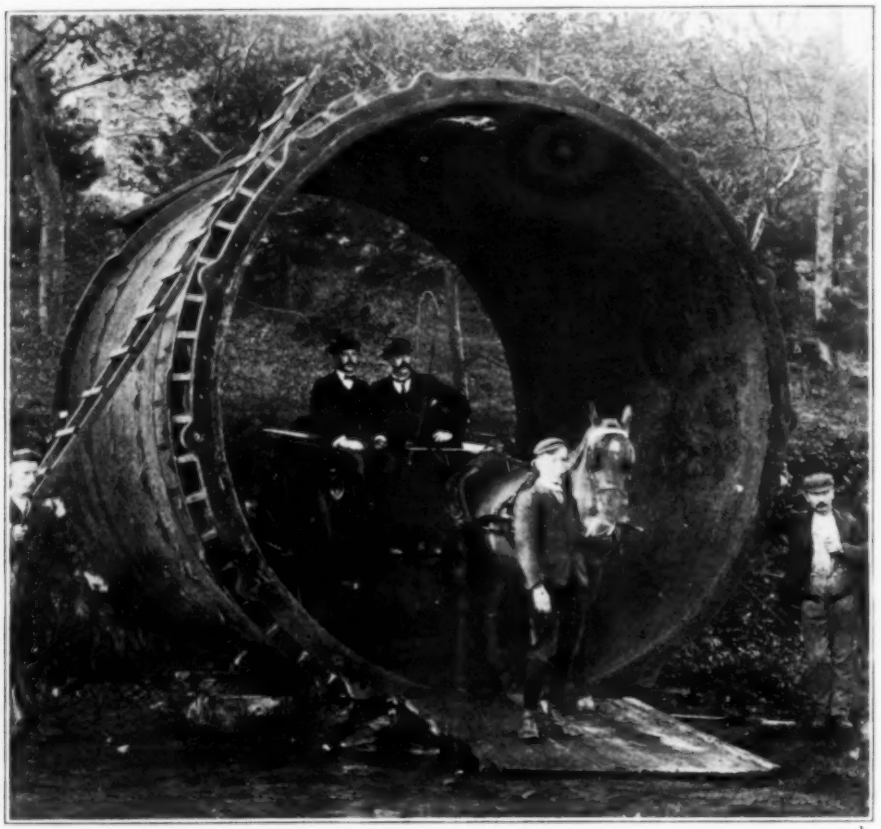
The following statement also is made: "Recently, some improvement has been noticed attributed partly to wider bearing surfaces, and the application of

chills on wearing parts, combined with the use of semisteel."

The writer was the melter in a foundry in a machine tool center several years before the war, and melted 50 to 60 tons of iron per day for the machine tool trade. Several grades of iron and semisteel were made for parts subject to wear. In addition, chills were used liberally on surfaces subject to excessive wear. The grain of the iron and its hardness received special attention, and frequent trips to the machine shop were customary to keep in close touch with the quality of the products. The practice mentioned was not an inovation at that period, but was the usual practice. The writer has seen the same care taken in other foundries making machine tool castings.

The emergencies of the war brought many novices into industry and interferred seriously with the quality of the output in establishments of long standing. Coke, sand and metals were extremely difficult to obtain and the grade was often unfitted for the products that had to be made regardless of standards.

The writer was superintendent of a foundry during the war which was asked to make castings for a machine tool company. The mixtures used in that foundry were not suited for machine tools and the foundry organization previous to the writer's time was not familiar with machine tool requirements. Naturally it occurred to me then that machine tool companies would have difficulties, for they were obliged to buy castings of any foundries that could make deliveries regardless of their lack of the special knowledge needed to produce strong machine tool castings with good wearing qualities. For long periods we had to forget about mixes for our castings, and mixed mostly by fracture and observation of the product as it was useless to get an analysis for we could not get the proper pig iron. The analysis of one carload of coke showed 20 per cent ash and we had to use it or shut down. If we had shut down we would have lost our force for the labor turnover was high anyway, so we used the coke for several days and specialized on the *standing order* for scrap.



FROM AN OLD PHOTOGRAPH OF A PUMPING ENGINE CYLINDER MADE IN CORNWALL, ENGLAND, 40 YEARS AGO

Pittsburgh Annual Field Day Observed

The annual summer outing of the Pittsburgh Foundrymen's association was scheduled for June 26 at Turner Park, Perrysville, Pa. The members of the association and their guests were transported to the park in automobiles. A ball game and many other entertainment features comprised the program of events, and dinner was served in the evening.

Recalls Large Cylinder Made in England

Commenting on the answer to an inquiry in a recent issue of THE FOUNDRY touching on the weight and dimensions of the largest cylinder ever cast in this country, Edwin Jory, foundry superintendent, National Transit Pump & Machine Co., Oil City, Pa., submits a photograph reproduced in the accompanying illustration of a cylinder made in England about 40 years ago. It was cast in the foundry of Harvey & Company, Hayle, Cornwall, where Mr. Jory was an apprentice and attracted considerable attention among British foundrymen at the time. It was designed for service in connection with the water pumps on the dikes in Holland and was machined on the inside to a diameter of 12 feet.

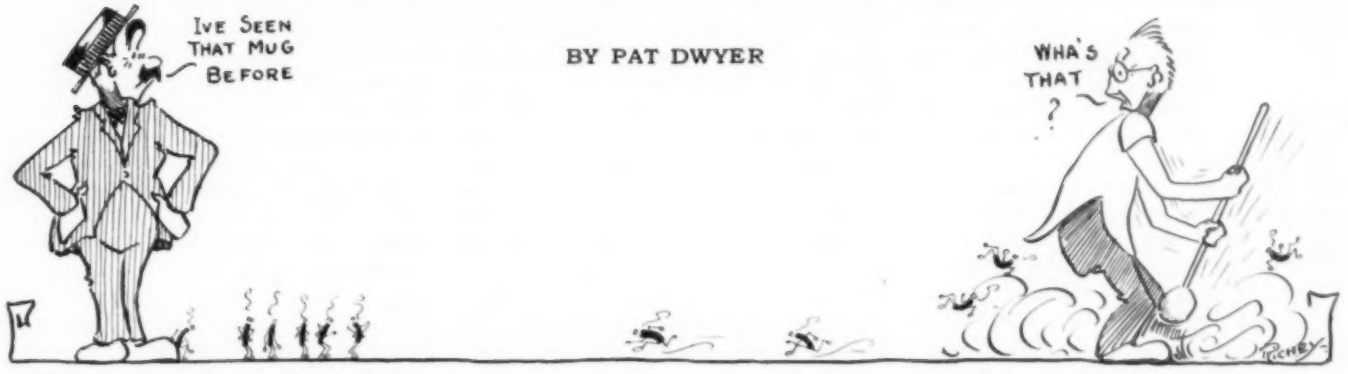
The mold and core for this job were swept up in loam. The mold was made in a pit and the core was made on the floor and afterward lowered into place with wall jib cranes. Contrary to the usual American practice of a stationary core and a revolving sweep, the core was built on a plate which was revolved past a stationary sweep. This custom still is prevalent in certain parts of England and other European countries. The iron was melted in an air furnace and poured from ladles suspended from the same cranes employed for handling the core plates and other parts during the previous operations.

Engineering problems incident to the production of such a large casting with the comparatively crude equipment at hand did not cease with the actual pouring of the mold. There still remained the problem of shipping it to its destination. The harbor at Hayle could not accommodate the larger boats and none of the small boats were constructed in a suitable manner to support the casting. Finally a boat, in course of construction was remodelled to a certain extent to permit the casting to be lowered into the hold and braced there. The cylinder was rolled from the foundry to the loading dock as shown in the illustration.

Opens New Spar Mine

Hill Fluor Spar Mines, Chicago, has opened a new mine on the original Rosiclare vein, Rosiview Station, Ill. Concrete storage bins drained and covered insure dry spar which is loaded by belt conveyors direct from the storage bins into cars on the Illinois Central railroad siding.

Bill Discusses Pulley Molding Problems



BY PAT DWYER

MANY years ago while I still was in the butterfly stage, light and airy and free to flit from place to place I happened to light in a certain town where I secured a job in a steel foundry. To a certain extent, the job was merely incidental. I did not go to the town with the single purpose of finding a job, working at it diligently, saving all my money, acquiring an interest in the firm, marrying the president's daughter, finally selling out to the trust, retiring to my country estate, and then peacefully dying without a will so that my surviving relatives would be sure to remember me. I should say not.

If I had sense enough at that stage to foster an ambition of that kind, I should never have left home. I could get all the work I wanted there. In fact I don't think I ever worked harder in any of the many shops I have favored with my presence than I did in the shop where I served my apprenticeship. My only ambition after I left home was to see as much of the country as I could in the shortest possible time and since I had to eat and sleep—occasionally—I was compelled to exchange my labor for a modest stipend or honorarium based on an hourly rate and paid in a lump sum, usually twice a month. True, the lump was never of alarming proportions and it evaporated in the swiftest and most alarming manner long before the following installment was due. However, my wants were few and comparatively inexpensive in those days. I had all the clothes I could wear at one time, a place to eat and sleep, freedom to come and go as I pleased, a notable appetite and a clear conscience and consequently was as nearly ideally happy as it is possible for any person to be in this vale of tears. I remained in the town about four months, then one day I drew my back time gathered up my tools, had a bath and a shave and when a big passenger steamer pulled away from her dock that night. I sat on the after deck and took what was destined to be my last look for over 20 years at the buildings facing the water front.

Recently I revisited the city and among other points of interest made a tour of one of the principal foundries. The manager kindly accompanied me, but was called away before we had gone any considerable distance. He regretted the necessity of leaving me alone for a few minutes, but said if I kindly would wait in the immediate vicinity he would return as soon as possible and explain the various processes incidental to the manufacture of castings. I told him not to hurry. I was familiar with the rudiment of foundry practice and felt that I should be able to find my way around, alone if necessary. On the remote chance of finding a familiar face I looked rather closely at the various workmen as I walked around and at last was rewarded by the sight of a countenance that I knew. He, that is the owner of the face, had worked near me in the olden days in the steel foundry and had worn a moustache. He now was plain faced, rather weather beaten and in addition was equipped with a pair of spectacles. I might have hesitated in the case of almost any other person because appearances some times are deceiving and 20 odd years is a long time, but this man had the most finely developed specimen of a roman nose it ever has been my pleasure to notice on a human being, so I felt reasonably certain that two such remarkably endowed individuals could not be found in the same town.

With a view of finding whether or not he would recognize, or remember me, I walked over to where he was working, put one foot up on the edge of the flask and asked him if he thought there was any use in me hitting the old man for a job. He looked at me without a gleam of recognition, solemn as an owl, over the spectacles, and said he thought not, in fact he had heard they were going to lay a gang off that night. I then addressed him by name and referred to the fact that we both had worked in the steel foundry in a certain year. He admitted to working there at the time, but had not the least recollection of ever having seen me before. I mentioned the names of several men who also had worked there at the time, including Bill, and he remembered them all distinctly, but could not place me. Personally it was a rather mortifying experience, but I was glad to find that he had not forgotten Bill and further pleased when he begged me to convey his best wishes to the old boy.

I did not consider the message of sufficient importance to warrant a special trip over to Bill's house, but one night shortly after my arrival home, I rambled over to pay a friendly visit and among other fragments of a more or less disjointed conversation I told Bill about this molder I had met recently and expressed surprise that he still was in the same town. "Well" said Bill, "I did not know he was back there again, but he certainly has not been working steadily in that town since you saw him before. The last time I saw him several years ago, he was working for the *G. E.* in Schenectady. I met him one night at Tim's Place, one of the prominent rest houses and havens of refuge

REMEMBER THE STUFF THAT MADE MILWAUKEE FAMOUS

provided by the brewery interests along all the principal streets. He just had returned from a tour of the Southern foundries and had some interesting experiences to relate, particularly in connection with the peculiarities, habits and customs of the colored helpers. He said that on account of the heat, these jolly lads dispense with nearly all clothing while engaged in their daily work and probably would romp around stark naked if the management would permit them. Occasionally they wear shoes, but prefer to paddle around in their bare feet. In time the soles become so hard and calloused that the owners experience no discomfort while walking over lumps of coke, clamps, gaggers or even red hot foundry scrap. As an extreme instance he recited the case of the colored boy engaged in pouring a ladle of iron. One bare foot rested on the clean floor and the other was parked on top of a long flat runner, still red hot, that had just been broken off a nearby cope and thrown into the gangway. The man at the other end of the ladle saw the smoke rising and had a whiff of the burning hoof, but he did not get excited. Why should he? His feet were not burning. He addressed his partner in an ordinary conversational tone. 'Say, Sam,' said he, yo' foot am bu'nin'.' Sam was only mildly interested, he kept right on pouring the ladle and inquired indifferently 'which one?'

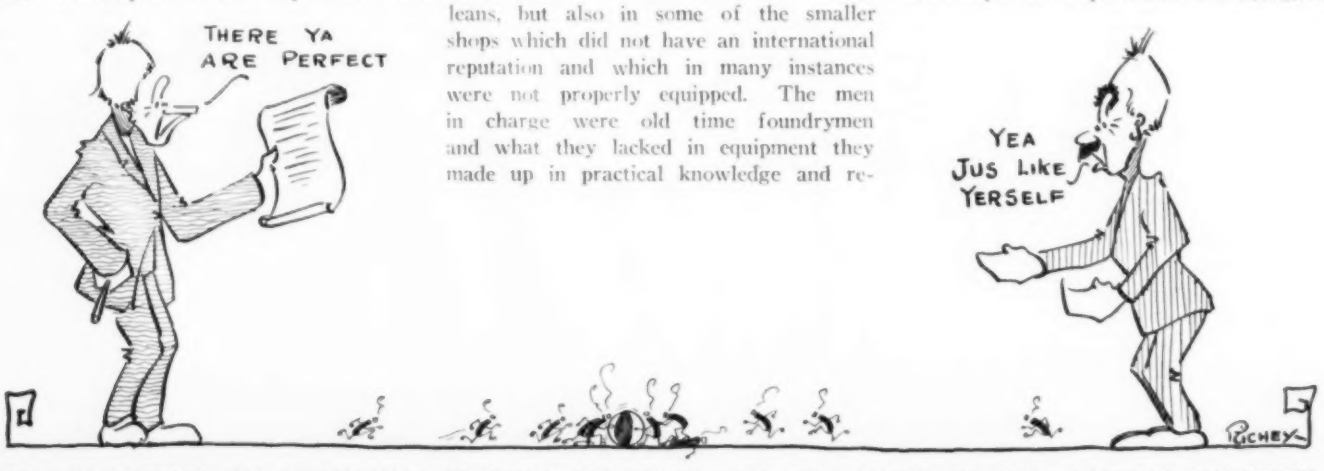
"Those who wear shoes might almost as well go bare foot for all the protection the shoes afford them. In addition to the cracks and crevices incident to hard usage, every shoe owner finds it necessary to slash the shoe in various places with a knife, or razor. One prominent foundry company in an effort to introduce safety methods, bought a supply of special foundry shoes and presented a pair to each man engaged in the foundry. The manager made a tour of inspection the day after the shoes were issued and found that there was not a single pair intact. He found them with holes cut in the heel, with holes, over every toe, with slashes between the toes and in some instances with a row of holes along each side like the port holes on an old fashioned battle ship. In an informal report to his colleagues in the office he stated that it was no use trying to put safety shoes on these birds, for to the best of his knowledge and belief, they breathed through their feet. Hereafter, the only kind of shoes he would buy would be mule shoes to be fastened on by a blacksmith, or wooden sandals provided with leather packets at one end into which they could insert several toes and allow the remainder to dangle at ease over the edges. Heel straps would be optional and left to the discretion of the wearer. A certain amount of effort is required to adjust and fasten these straps in place and while some of the men might be inclined to this extra effort it was felt that the majority would not and the trailing heel straps would constitute an additional hazard and taking it all in all, up and down and by' and large, it was the final consensus of opinion that heel straps be omitted from the proposed sandals.

HOW CAKE WALKING STEPS ORIGINATED

"He claimed to have seen some remarkably nice castings, especially in the sugar mill line, made, not only in the big shops like Joubert and Goslin's in Birmingham and Bancroft's in New Orleans, but also in some of the smaller shops which did not have an international reputation and which in many instances were not properly equipped. The men in charge were old time foundrymen and what they lacked in equipment they made up in practical knowledge and resourcefulness. They had the *know how*.

"He instanced one trick he had seen pulled off in a little shop down on the Gulf coast which struck me as rather odd. It may have been practiced elsewhere and at other times, but I had neither seen or heard of it previously. You know, of course that there are about as many methods for molding pulleys as there are for killing a cat. The method adopted depends to a great extent on the size and type of pulley required, the existing equipment and the relative size of the order. It is apparent that a makeshift method perfectly justifiable where only one or two castings are needed, would not be satisfactory where hundreds or even thousands are made. Likewise, on production work a method that would produce small pulleys could not be employed for making large wheels. Again, in many cases even in pulley shops where a large stock of pulley patterns are available, an order comes through for an odd size and then the foundryman's ingenuity is taxed to manipulate one of the existing patterns so that it will serve. Not only may the arms and hubs be changed, but by employing suitable lagging either inside or outside of the rim it is possible to change diameter of the pulley wheel to practically any required dimension. However, what I started to tell you about was an ingenious variation of one of the methods usually practiced when the pulley is poured in an open sand mold. To be strictly accurate the arms and hub are covered, but the rim is left open and therefore in the rather loose parlance of the foundry, the mold is referred to as an open sand mold.

"The wheel was 6 feet diameter, 10-inch face with 6 elliptical arms and the hub was 12 inches deep, or 2 inches deeper than the rim. If the casting had been made in a flask, that feature would have required no particular consideration.



but since the pulley was to be molded with the top of the rim open, it is apparent that some measure had to be adopted to hold the iron at the rim level while the hub was filling to the top with iron. Molten iron, like any other liquid, will fill to the level of its source of supply, if it is held between perpendicular walls, otherwise it will escape at the lowest unprotected point. This characteristic is familiar to foundrymen in the *runouts* where the metal either bursts through the bottom of the flask, or, breaks out at the joint of the mold.

"In this particular instance an iron rim and a set of wooden arms and hubs were available for the size pulley required. In addition it was found that an existing set of lifting plates and a suitable binder plate already was in existence. In fact, if this rigging had not been available, it is probable some other method would have been adopted for making the wheel. It may be claimed that the rim could have been drawn up to a point where the open top of the mold would have extended higher than the top of the hub, but that would have meant extending it about 6 inches to prevent the metal from flowing over before the riser was filled. While a band of iron 1-inch thick, 6 feet in diameter and 6 inches high does not amount to much, still is represents about 350 pounds and the expenditure of a few dollars in making the extra part of the mold and melting the iron. Usually, in a small shop the small leaks receive more attention than they do in the larger establishments where castings are put through in wholesale lots.

"The rim was bedded level in a hole in the floor and the diameter carefully measured at several points to make sure that the pattern had not sprung or sagged out of shape. To those not familiar with iron pulley patterns this precaution may seem unnecessary, but foundrymen who employ these, or similar patterns, know that they are easily distorted. It is necessary to check them for accuracy, perhaps not every time they are used, but certainly the first time they are used after being out of the sand for any extended length of time. To economize space and also because it is the most convenient method, iron pulley patterns usually are stored in the pattern department in such a manner that all the weight rests on the face at one point. The pattern naturally sags from the shape of a true circle and if allowed to stand in that position for any considerable length of time the sag will become permanent. It may be only ¼ or ⅜ inch but pulleys usually are machined to close limits and in addition they must balance so that they may run true at high rates of speed. It is apparent that it will be impossible to machine a balanced pulley in which one diameter differs from another drawn at right angles, by ¼-inch or more.

"In this instance two sticks, the proper diameter, were jammed across the interior of the pulley pattern at right angles and then the space between the outside of the rim and the hole in the floor was filled with sand, packed firmly, not hard, but firm. The sticks then were removed and the sand held the pattern in its proper shape. Sand then was rammed on the inside of the pattern ring to a height of about 3 inches. A suitable hole was left in the center for the deep hub and then the arms and heel were set in place. A wedge under each arm was used to adjust them to correspond with a piece of board provided with a shoulder resting on the top of the rim. The center of the arm was set about 1 inch below the center of the rim. In this manner 1 inch of head metal was provided on the rim of the casting to be cut off later in the machine shop. This was to insure that the top of the rim would be clean and solid.

"Facing sand was tucked under the hub and arms and after the parting was made, an iron plate provided with a 1-inch nut in the center, was set in place between each pair of arms. A bolt threaded at both ends was screwed into each nut and then the inside of the pattern was filled with sand and rammed. A straight edge was employed to scrape off the sand flush with the pattern inside and outside after which a circular plate almost the full diameter of the inside of the pulley and provided with holes for the bolts and a large hole in the center to clear the runners and riser, was set on and screwed down tightly. The ring pattern then was drawn and with the clearance thus provided, a clean *lift* was assured when the crane was attched to suitable loops in the top plate provided for the purpose of lifting the body of sand forming the interior of that part of the mold above the arms. After the mold was finished and the arms and hub blacked, it was reassembled, weighted, and a long runner made up extending from outside the rim to the center.

"All the foregoing, of course is routine practice and it was not until the mold was poured that this foundryman added the distinctive touch. At the point where the metal had reached the top of the rim, but still was 2 inches short of filling the hub, pouring was stopped for a few seconds while water was applied with a swab to the iron showing in the rim. The iron cooled instantly and then pouring was continued until the hub and riser were filled.

"I should like" said Bill in conclusion, "to see a good, comprehensive description of pulley molding, commencing with the little ones and progressing up through the different sizes. I have made them and seen them made in many ways, but I also have rambled around the country enough to know that I have not yet arrived at the stage when I can say that I have seen everything."

"Well" I said, "why don't you go ahead and write a description of your own?"

"Now that you mention it" said Bill "the idea may not be as foolish as you probably think it is. The only feature I dont like about it is that I won't be able to find any fault with it after it is written. However, that is a detail that will be taken care of in a comprehensive if not a vindictive manner by those eagle eyed birds constantly on the lookout for loop holes in the written word to which they may direct their arrows."

Equipment Men Meet

Officers of the American Foundrymens' association, and representatives of the member companies of the Foundry Equipment Manufacturers' association were guests of the latter organization at a dinner at the Powers hotel, Rochester, N. Y. on the first evening of the foundry convention. V. E. Minich, American Foundry Equipment Co., New York, past president of the association, was given a pearl stickpin in token of esteem and in appreciation of his deep interest in the welfare of the organization. F. J. Cook, past president of the Institution of British Foundrymen and C. R. Messinger, president elect of the Foundrymens association, spoke briefly. F. G. Smith, Osborn Mfg. Co., Cleveland, president of the equipment manufacturers association presided.

Removes to New Plant

The Mott Sand Blast Mfg. Co. has moved from its former location at 24 South Clinton street, Chicago, to a new plant at 3101-3111 West Twenty-seventh street, where it will have much better facilities for manufacturing. U. H. Dernehl is president of the company, D. Mayor, vice president and W. C. Schmitz, secretary-treasurer.

Orton & Steinbrenner Co., manufacturer of locomotive cranes, grab buckets and coal crushers, has removed from the 11th to the 19th floor of the Transportation building, 608 South Dearborn street, Chicago.

The Wisconsin Gray Iron Foundry Co. has been organized to take over the Atlas Foundry Co., West Allis, Wis. Jack Burke, formerly of the Chain Belt Co., is president, and E. P. Freeman factory manager.

Study American Iron Castings

Opening Sessions of Institution of British Foundrymen Devoted to Discussion of Malleable and Semisteel—International Move Suggested at Rochester is Furthered—Exhibition Is Large and Well Attended

BY H. COLE ESTEP

By Special Cable to THE FOUNDRY

WITH visitors from many parts of the British Empire, continental Europe and the United States, the first combined foundry convention and exhibition to be held in Great Britain opened in Birmingham, England, June 15. It was a pronounced success both from the commercial and technical standpoints. Birmingham is one of the largest foundry centers in the British Isles. The convention was under the auspices of two important British societies, the Institution of British Foundrymen and the British Cast Iron Research association, the exhibition being under the management of the Birmingham Chamber of Commerce.

The opening session of the Institution of British Foundrymen was featured by the presentation of the first Oliver Stubbs medal to F. J. Cook, Rudge Littley, Ltd., West Bromwich, England. This medal, which is to be presented annually, is supported by funds procured from a trust provided by the National Iron Founders Employers Federation. Its object is to encourage and reward efforts made by the members of the institution to impart knowledge on the theory and practice of castings manufacture. In awarding this signal honor to Mr. Cook, his services to his industry are recognized. It will be remembered that Mr. Cook represented the Institution of British Foundrymen and presented the first exchange paper sent by that technical association to the American Foundrymen's association. His paper invoked much helpful discussion at the meeting held in Rochester June 6.

The attendance at the sessions tripled any previous gathering held by the institution. Great impetus was imparted to the plans for holding international meetings for the discussion of technical foundry subjects. Enrique Touceda, Albany, N. Y., presented an able exchange paper on American malleable casting production. He was greeted with great enthusiasm and his paper was discussed by international experts including L. Piedbouef, Peries et Ateliers Simmon, Liege, Belgium; Prof. Thomas Turner; Oliver Stubbs and F. J. Cook, all eminent English authorities and Stanley F. Flagg, Jr., Stanley G. Flagg & Co., Philadelphia. American malleable castings were conceded by all to be superior, but several speakers, led by Mr. Cook, pointed out their belief in the superiority of European gray iron.

In discussing the paper "Manufacture of Semisteel" by J. Cameron, Kirkintillock, Scotland, European recognition was given to the importance of semisteel as developed under American initiative, but at the same time the recommendation was made that the name be changed to *toughened* gray iron.

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JUNIOR VICE PRESIDENT
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TREASURER
F. W. FINCH.

SECRETARY
W. G. HOLLINGWORTH.

Proposes Paris Meeting

At an informal luncheon tendered by retiring President Oliver Stubbs to foreign guests including E. Ramas, president of the French foundry association; Joseph Leonard, president of the Belgian foundry association; Stanley G. Flagg, Jr., past president of the American Foundrymen's association and 10 other noted guests, E. Ronceray, president Societe Anonyme des Estabissements Ph. Bonvillian & E. Ronceray, Paris, proposed an international conference and exhibition devoted to the foundry industry to be held in Paris in 1923. The international movement was given encouragement at the annual banquet held Wednesday night by Mr. Flagg representing the American, French and Belgian delegates.

Officers who were declared unanimously elected, included H. L. Reason, Birmingham, president; H. Jewson, E. Dereham, senior vice president; R. O. Patterson, Newcastle, junior vice president; F. W. Finch, treasurer; and W. G. Hollingworth, secretary. Both of the latter officers were re-elected. The 1923 meeting of the institution will be held in London and the following year the meeting will be held at Newcastle. Communications were read from C. R. Messinger, president of the American Foundrymen's association, and a cablegram of felicitation from the latter association was presented.

Thursday, June 22, and the two following days were devoted to the reading and discussion of papers, plant visitation and excursions to points of interest.

Over 70 concerns, of which three were from the United States, participated in the display of foundry and shop equipment and supplies at Bingley Hall. The exhibition was opened by Lord Weir, chairman of arrangements, and was visited by the Duke of York.

The show offered visitors an opportunity to see for the first time in England, British, French, American and and other molding machines and foundry equipment operating side by side. No German exhibits were permitted. One of the features of the exhibition was the number of new types of molding and core-making machines displayed, including French hydraulic jarring machines; British pneumatic-electric machines in which a single cylinder serves both as air-compressor and operating cylinder of the jar-ramming table; and what is believed to be the first hand-operated jar-ramming machine ever produced on a commercial basis, also of British manufacture. Cupolas of an advanced type also were displayed.

The latter were exhibited by the Constructional Engineering Co., Charles Henry Street, Birmingham; the manually operated jarring machine by the Adaptable Moulding Machine Co., Stanhope Street, Birmingham, and the electric-pneumatic machine by the Pneulec Machine Co., Smethwick. A complete list of the exhibitors is presented herewith.

The American exhibitors included The Osborn Mfg. Co., Cleveland, which was represented by its general European director, M. W. Zeman; McLain's System, Milwaukee, represented by its founder, David McLain; and The Penton Publishing Co. The Osborn Mfg. Co., showed models, photographs, draw-

ings, etc., together with engineering data, covering its line of molding machines; McLain's System showed specimens of semisteel castings and technical data on the production of semisteel and correct melting practice. The Penton Publishing Co. showed its publications, including THE FOUNDRY, *The Iron Trade Review, Daily Metal Trade and Abrasive Industry,* together with its technical books. and comprehensive series of photographs illustrating American practice.

The arrangements for the comfort and entertainment of the visitors were unusually complete. They were carried out by the conference reception committee of 43 members headed by H. Field, president of the Birmingham Branch of the Institution of British Foundrymen, and assisted by Thomas Vickers, honorary secretary and N. A. Denson, honorary treasurer of the local foundrymen.

Book Review

The Steel Foundry; by John Howe Hall, metallurgical engineer, Taylor-Wharton Iron & Steel Co., Highbridge, N. J.; cloth; 334 pages, 6 x 9 inches; published by McGraw-Hill Book Co., Inc., 370 Seventh avenue, New York City, and furnished by THE FOUNDRY for $4 net.

The object of this book is to set forth the metallurgy of the steel foundry from the point of view of the engineer who constantly keeps in mind that his is a profession whose usefulness consists in prescribing the cheapest means of producing objects of sufficient excellence for the purposes intended. Consideration is given in this volume to the classes of steel castings in demand in this country at present, with their characteristics from a manufacturing viewpoint; the different types of steelmaking processes with their characteristic features such as relative cost of installation, cost and quality of steel produced, etc., the use of one or another for manufacturing the kind of castings desired; shop practice in molding, pouring and annealing and its influence on the quality and cost of the product.

After a general description governing the choice of a steelmaking method in which comparison is made between basic and acid open hearth; bessemer and crucible and the cost of castings produced by each method.

The second section, 54 pages, well illustrated, touches on general features of the bessemer process, low installation cost, convenience for intermittent operation, description of bottom and side blow vessels, special types, layout of a bessemer shop, cupola practice and manipulation of the charge.

Many illustrations appear on the 55 pages devoted to the open-hearth process. The description covers practically all features including furnace construction, layout of an open-hearth shop, acid and basic bottom, repairs, tapping, acid melting process, basic melting process, details of operation and typical heat cards, manufacture of high carbon and alloy steels.

The fourth section is given over to a description of the electric furnace in general, one type described in detail, layout of electric furnace foundry, making the bottom, the basic process, the acid process, discussion of raw materials required, and alloy steels produced.

Problems and practice incident to molding, pouring and digging out, are considered in the 43 pages comprising a fifth section. Special reference is made to molding and core sands, binders and methods of venting, defects in castings, causes and preventives, handling molten metal. The sixth section illustrated with numerous micrographs deals in considerable detail with heat treating and annealing. The book concludes with three short chapters on finishing, straightening and welding respectively; laboratories and an abstract from an article which appeared in the technical press in 1913 entitled *Building Up Impurities in Steel.* A comprehensive alphabetical index at the back furnishes a ready reference.

Exhibitors at the British Foundry Show

Macdonald, John, & Son, Ltd., Watt street, Maryhill, Glasgow.
Ritchie, Hart & Co., Ltd., Mount Pottinger Foundry, Belfast.
Universal Systems of Machine Moulding, 97 Queen Victoria street, London, E. C. 4.
Thwaites Bros., Ltd., Vulcan Iron Works, Bradford.
Penton Publishing Co., Cleveland, Ohio and Caxton House, London, S. W. 1.
Cumming, William, & Co., Ltd., Kelernvale Mills, Maryhill, Glasgow.
Hingley, N., & Sons, Ltd., Netherton Iron Works, Dudley.
Richardson, R. J., & Sons, Ltd., Commercial street, Birmingham.
Monometer Mfg. Co., Ltd., 115 Strand, London, W. C. 2.
Portway, Charles, & Son, The Tortoise Stove Works, Halstead, Essex.
Herring & Son, engineers, Chertsey.
Avery, W. & T., Ltd., Soho Foundry, Birmingham.
FOUNDRY, THE, Cleveland, Ohio, and Caxton House, London, S. W. 1.
Foundry Trade Journal, London, W. C. 2.
Magnesium Co., Ltd., 34a Buckingham Palace road, London, S. W. 1.
Rudge, Littley, Ltd., Swann village, West Bromwich.
Louis Cassier Co., Ltd., London, W. C. 2.
Beardmore, William, Ltd., 183 West George street, Glasgow.
Major Robinson & Co., Ltd., Scols Works, Sykes street, Hulme, Manchester.
Wadkin & Co., North Errington, Leicester.
Amalgams Ltd., 186 Attercliffe road, Sheffield.
Hoyt Metal Co. of Great Britain, Ltd., The, Deodar road, Putney, S. W. 15.
Iron Trade Review, Cleveland, Ohio, and Caxton House, London, S. W. 1.
McLain's System Inc., Goldsmith Bldg., Milwaukee.
Hudson, Ernest F., 116 New street, Birmingham.
Baker, Joseph, Sons & Perkins Ltd., Kingsway, London, W. C. 2.
Carbic Ltd., 51 Holborn Viaduct, London, E. C. 1.
Shotts Iron Co. Ltd., 1 Castle street, Edinburgh.
Foster Instrument Co., Letchworth, Herefordshire.
Handyside, Andrew & Co. Ltd., Britannia Iron Works, Derby.
Woollen & Co. Ltd., 38 Holly street, Sheffield.
Cambridge & Paul Instrument Co. Ltd., 45 Grosvenor place, London.
Morgan Crucible Co. Ltd., Battersea Works, Church road, London, S. W. 11.
Brooks (Oldbury) Ltd., Oldbury, near Birmingham.
Fordath Engineering Co. Ltd., Hamblet Works, West Bromwich.
Selas Turner Co. Ltd., Priory street, Coventry.
Allday & Co., 38 Paradise street, Birmingham.
Priestman, T. J., Leopold street, Birmingham.
British Reverberating Furnaces Ltd., 82 Victoria street, London, S. W. 1.
Adaptable Moulding Machine Co., Stanhope street, Birmingham.
City of Birmingham gas department (industrial research laboratories), Birmingham.
Necol Industrial Collodions Ltd., 62 London Wall, London, E. C. 2.
Herbert, Alfred Ltd., The Butts, Coventry.
Alldays & Onions Ltd., Great Western Works, Birmingham.
Williams, John (B'Ham Sand) Ltd., Foundry Sand Quarries, Icknield Sq. Wharf, Birmingham.
Phillips, J. W. & C. J., Ltd., 23 College Hill, Cannon street, London, E. C. 4.
Birtley Iron Co., Birtley, Durham.
Tower Publicity Bureau (Spermoline Ltd.), Palatine Chambers, Market street, Halifax.
Consett Iron Co. Ltd., Consett, Durham.
General Refractories Co. Ltd., Kelham Island Firebrick Works, Sheffield.
Universal Grinding Wheel Co. Ltd., Universal Works, Stafford.
Booth, Samuel & Co. Ltd., Cheapside Works, Birmingham.
Crossley Bros. Ltd., Openshaw, Manchester.
Pneule Machine Co. Ltd., Roebuck Lane, Smethwick.
Constructional Engineering Co. Ltd., Titan Works, Charles Henry street, Birmingham.
Macnab & Co., 56-58 Eagle street, Southampton row, London, W. C. 1.
Britannia Foundry Co., Cox street, Coventry.
Rowland, B. R. & Co. Ltd., Reddish, Stockport.
Sainsbury, A. W. Ltd., Campo Lane, Sheffield.
Turnbull, James, 3 New street, Birmingham.
General Foundry & Eng. Co. Ltd., Lutterworth.
Osborn Mfg. Co., Cleveland, Ohio.
National Time Recorder Co. Ltd., 12 Easy Row, Birmingham.
Iliffe & Sons Ltd., London, E. C. 4.
Hermansen, A., County Chambers, Corporation street, Birmingham.
Oak Foundry Ltd., Tiverton road, Bournbrook, Birmingham.
Shaw Hardware Co., 69 Broad street, Birmingham.
Canning, W. & Co., Great Hampton street, Birmingham.
Salter, George & Co. Ltd., West Bromwich.
Street, William & Sons, 184 Bristol street, Birmingham.
Nicholson & Clipper Co. Ltd., King street, Salford, Manchester.

Correcting Flaws in Metal Mixtures

Problems of the Gray Iron, Malleable and Steel Foundry Discussed

By H. E. Diller

Composition for a Roll

Question—We are making gray-iron rolls for paper machinery, about 18 inches in diameter and 72 inches to 90 inches in length, designed in such form that the ends are used as journals 6 inches to 8 inches in diameter. The cores of these rolls leave a wall about 2½ inches in thickness. The castings are made in dry-sand molds on end and have to be of good machining iron, as close grained as possible and free from all blow holes. In order that these rolls be properly balanced when finished, about ½ inch is allowed for finish all over. We would be pleased if you could advise us what the general practice is relative to the composition of iron for similar castings.

Answer—The composition of rolls like you mention should be

Silicon, 1.75 to 2.0 per cent.
Sulphur, less than 0.12 per cent.
Phosphorus, 0.4 to 0.6 per cent.
Manganese 0.5 to 0.9 per cent.

The mixture would be benefited by the use of 15 per cent steel in the heat. This should be placed directly above the coke on each charge, before the scrap and pig iron.

High-Sulphur Scrap May Be Used in Mix

Question—We purchased a quantity of scrap iron from an acid plant and find there is a large amount of sulphur in the metal. Will this sulphur be injurious to the mixture to which this scrap is added?

Answer—Sulphur has a tendency to harden iron, but we would not be able to say whether the amount of sulphur which you have in your castings would be injurious unless we knew the exact percentage of sulphur. Iron may be used with as high as 0.20 per cent sulphur if it is handled right and contains approximately 0.8 per cent manganese and sufficient silicon. The amount of silicon will be dependent upon the thickness of the section of the casting into which the iron is to be poured. The effect of this scrap on the iron will depend upon the quantity used on a charge. It would be well to start using only a small percentage of the high-sulphur scrap and increase the amount until you notice bad effects in the castings, then cut down the amount. Or, better still, have the castings analyzed for sulphur and do not increase the proportion of high sulphur scrap after the sulphur content of the iron amounts to 0.160 per cent.

Forming Iron Balls

Question—We cast annually several hundred thousand ⅝-inch iron balls. We use a gate casting with 72 balls to the mold. This method makes it necessary that the balls be ground. It is our understanding that steel balls are made by dropping the steel into water. Would it be advisable to undertake a similar method with grey iron?

Answer—We know of no case in which steel balls are formed by being dropped into water. Lead balls are formed in this way, but, of course, the two metals are entirely different in their melting points. Lead can be controlled easily in the molten state and can be heated to a temperature considerably higher than its melting point. Steel, on the other hand, is difficult to control in the molten state and probably would solidify so quickly on falling through the air that a perfectly round ball would not form. If steel could be dropped, cast iron certainly could be dropped also, but would be chilled.

Try to Substitute Semi-steel for Malleable

Question—We are considering the advisability of supplanting malleable iron with semisteel for some castings for agricultural machinery and would like to know the properties of semisteel in comparison with malleable iron and gray iron.

Answer—Semisteel would be entirely different from malleable iron in that it would be practically as brittle as cast iron. However, it would be approximately 50 per cent stronger than cast iron and in this way would be somewhat superior to it. For your work you should not use more than 12 or 15 per cent of steel in your mixture. The steel should be charged on top of the coke after which the pig iron and then the scrap should be added. This gives the pig iron and scrap opportunity to wash over the steel in melting and assists in melting the steel which melts at a higher temperature than the pig iron or scrap. By the addition of this amount of steel to the mixture, you should secure a metal with a tensile strength of at least 30,000 pounds per square inch. This, however as we have said, would be comparatively brittle and would not withstand shocks nearly so well as would malleable iron.

Constituents for Melting Point of Gray Iron

Question—How can the melting point of cast iron be raised to 2500 or 2600 degrees Fahr?

Answer—We would be glad to tell you how to raise the melting point of cast iron to 2500 or 2600 degrees Fahr. if such a thing were possible. However, 2300 degrees Fahr. is about the highest melting point you can secure with gray iron. The temperature which you mention is equal to the melting point of steel. The carbon and other elements in the gray iron lower its melting point and the only way to get up to the melting point of steel would be to reduce the amounts of carbon and other constituents in the gray iron and then you would no longer have gray iron.

Sources of Holes in Gray-Iron Castings

Question—We are losing a large number of gray-iron castings on account of small pin holes, some of which are only on the surface while others penetrate a half inch or more. Our mixture consists of half No. 2 pig iron and the other half a good grade of scrap.

Answer—The details you give are so meager that it is hard to determine specifically what your trouble is. It may be due to wet sand unevenly tempered, or it may be due to oxidized iron. The latter would be caused by having too low a coke bed or too high a blast. The coke bed should be at least 28 inches above the tuyeres and blast pressure should be not more than 14 or 16 ounces. Holes in the casting could also be caused by having a large percentage of sulphur in the iron with a small amount of manganese. The manganese should be at least four times the amount of sulphur in the iron. This could only be determined by chemical analysis.

Tips on Better Shop Practice

How Changes in Cores Saved Money—Shallow Cope Affects Strength of Pipe—Pour Steel Castings in Chill Molds—Steel Drum Made in Two-Part Flask

REDUCE the cost of production or perish. This admonition with its universal application perhaps applies with greater force to the foundry than to any other branch of engineering. Much can be accomplished along these lines if only the drafting room and the pattern shop would take to heart the foundry point of view. These departments, although outside the foundry, are greater factors in foundry costs than is generally acknowledged. They actually mark out the path to be followed, and, after securing essentials, this should be the path of least resistance. A slight alteration in design or the addition of a core print to the pattern may make all the difference between a cheap and a costly casting.

A case in point was recently dealt with by the writer, in which a considerable saving was effected in the foundry. One of the company's products required cast-iron side frames varying from 10 to 20 feet in length with ends and section as shown in Figs. 1 and 2. The frame is 18 inches deep with a 6-inch flange and a metal section of about an inch.

The bolt holes in each end were separately cored using small loose square cores which gave varying results, especially as the rapping and withdrawal of the pattern from the mold left the latter in a very disturbed condition.

A consideration of the foundry point of view resulted in the adoption of the design shown in section in Fig. 3, in which the center web, *A*, Fig. 2 is moved to one side, *A'*, Fig. 3, an obviously material improvement, as a flat cope is now used.

Further simplification was effected, and at the same time greater uniformity in the positions of the bolt holes insured, by the addition of one block print at the ends of the frames, as shown in Fig. 4. The core box for this arrangement, Fig. 5, is self-explanatory, and the advantages of making the small cores part of the block core is evident.

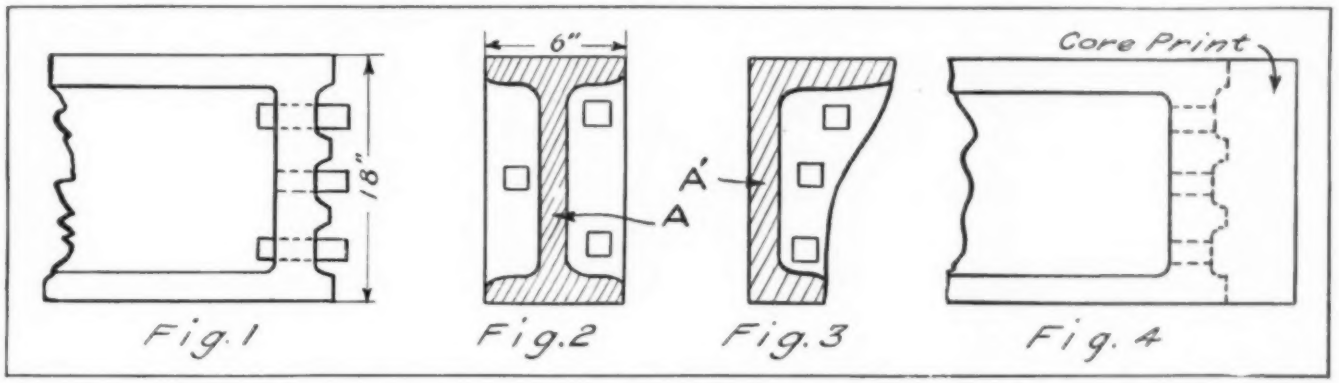
By F. C. Edwards

Shallow Cope Affects the Strength of Pipe

By Thomas Nelson

Personal experience and not theory has convinced me that a close and vital connection exists between the relative depth of a pipe flask cope and the ability of the resulting pipe to withstand pressure. At one time I worked in a foundry where a great many pipes were made for hydraulic installations. One pipe in particular 9 feet long, 6 inches inside diameter, ¾-inch thickness of metal with heavy 2-inch flanges at either end, caused a great deal of trouble. The molds were made in green sand and poured on an incline of about 9 inches in the total length. The metal was poured through two small pop gates on the flange at the high end. A loam core run up on a good stiff barrel and only requiring a single chaplet in the center on the cope side was employed. The castings were poured from a good grade of iron which withstood all the necessary tests on all castings except this particular pipe. They appeared to be satisfactory but when the test was applied they split sometimes from end to end and other times for a greater or lesser distance from the center, but always along the top center line of the pipe. Many remedies were tried including changing the grade of iron, changing the position of the gates and some of the molds were poured level instead of on an incline, but none of these remedies proved successful. The mold was made in an iron flask in which cope and drag were provided with similar sets of bars. In addition the drag was bedded on the floor instead of on a bottom board and therefore the trouble was not caused by a sag in the center.

In this particular case the cope only provided for a 3-inch thickness of sand over the top of the casting and as the bars were spaced 6 inches apart the molder making the job rammed the sand harder than usual to withstand the pressure of the rising iron. The result was that the iron rising on both sides of the core in the cope half of the mold, kicked and bubbled and did not properly unite along the top center line. Naturally this area was the weakest and when the pres-



FIGS. 1 AND 2—END AND SECTIONAL VIEWS OF SIDE FRAME BEFORE CHANGES WERE MADE FIG. 3—CHANGE IN SECTION MADE TO ADAPT FLAT COPE FIG. 4—HOW CORE PRINT WAS PROVIDED

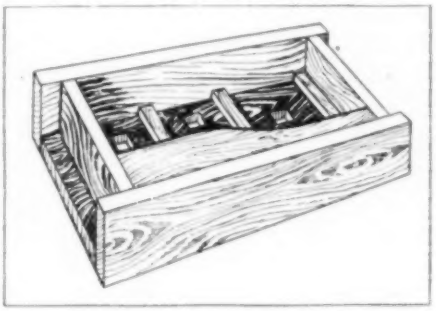


FIG. 5—COREBOX ARRANGEMENT TO PROVIDE BOLT HOLE CORE INTEGRAL WITH MAIN BLOCK

sure was applied to the pipe it burst along the line at this section in a short time.

It might be said that the cope could have been rammed to the proper density and then covered by a sand bed and a suitable weight to prevent the iron from forcing its way up among the bars. This remedy was tried but only partially successful inasmuch as it interfered with the free egress of the vent.

From a long and varied experience in molding pipes and columns I have learned that the sand on the cope side cannot be kept too soft or too open, that is while consistent with having it firm and adhesive enough to resist reasonable pressure. To secure this condition it is essential to have at least 6 inches of sand over the pattern and as a general rule the cope should be vented freely with a wire. The time required to shovel and ram the few extra shovels of sand required for an extra course will be well repaid in the enhanced strength of castings destined to withstand pressure and in the improved appearance of the skin on any pipe or column.

Pour Steel Castings in Chill Molds

BY W. H. ROESNER

IN A recent issue of THE FOUNDRY a correspondent asks the question whether steel castings can be made successfully in permanent molds. This is one of the questions which cannot be answered definitely either in the affirmative or the negative. An account of a series of experiments along this line conducted at different times and in various places may be of interest. The most elaborate and extensive were carried on with a machine designed to form center plates for freight cars. The machine was built on the general plan of a modern nonferrous die casting machine and was provided with a suitable water cooling system. It also was provided with knockout pins which ejected the casting when the mold was opened. Good castings were made on this machine but so much ladle trouble developed with a bottom pour 20-ton ladle that the device was discarded as a commercial failure. Shanking the steel from a present-day electric furnace might prove feasible with such a machine but whether the method would show a superiority over present high-speed molding machines is problematical.

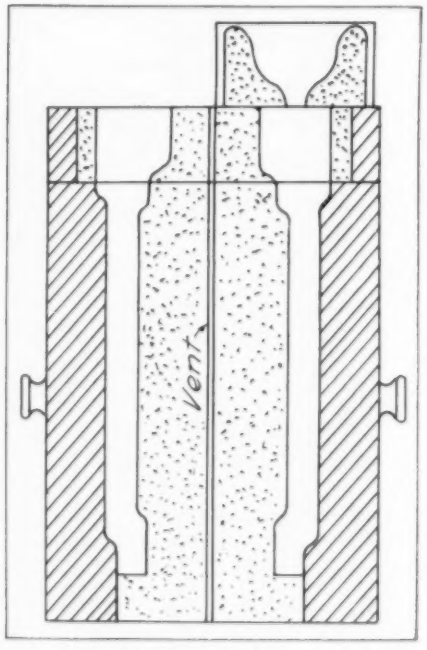


FIG. 1—THESE MOLDS HAD A LIFE OF ABOUT 100 HEATS

Several experiments were tried with molds for gears, pinions, etc., but the life of the iron molds was too short to warrant their continued use. The permanent mold for a certain size dummy shell shown in Fig. 1 rendered fairly satisfactory service. It was in effect an ingot mold and produced about 100 castings before it was scrapped. It was easily replaced since its finish involved no machine work of any consequence. Bessemer iron showed the best results in these molds.

By referring to the illustration it may be seen that the center core is provided with a shoulder which completely fills the mold cavity at the bottom. This construction automatically centers the core and also provides a sand surface on which the first metal can fall when poured through a runner cup set directly over the open mold. This method of pouring, eliminating as it did a long runner through the center core, saved about 20 pounds of steel on each casting. A light ring core, luted with fireclay into a suitable recess around the top of the mold served for a *hot top* after the mold was poured. Electric steel from a bottom-pour 3-ton ladle was used to pour these castings. The molds could be dumped a short time after they were poured and then were prepared for the following heat by being swabbed, while still hot, with a wash made of plumbago and molasses water. After the core was knocked out the head metal was cut off with an oxyacetylene torch. The casting then was ground, annealed and sandblasted.

The front wheel post and axle for a well known tractor was among the really difficult castings made in quantity. The wheel bearings *AA*, Fig. 2 were cast in chills. The iron chills were turned up true and a small hole drilled and tapped in each one by which to set it in the mold. The mold was made in green sand in the usual manner and after the pattern was drawn the gate was cut at *D* and the riser head at *C*. The chills were placed on the ends of the axle core as shown in the illustration and then the core which was made in one piece was lowered into the mold. The coreprints on the ends of the axles filled the chills and therefore there were no fins to prevent stripping the chills after the casting was poured. A small vent in the end of each chill allowed the gas to escape freely. The cores and chills were not set until a short time before the heat was ready, so that no chills were in the molds for any length of time exposed to the danger of gathering any moisture.

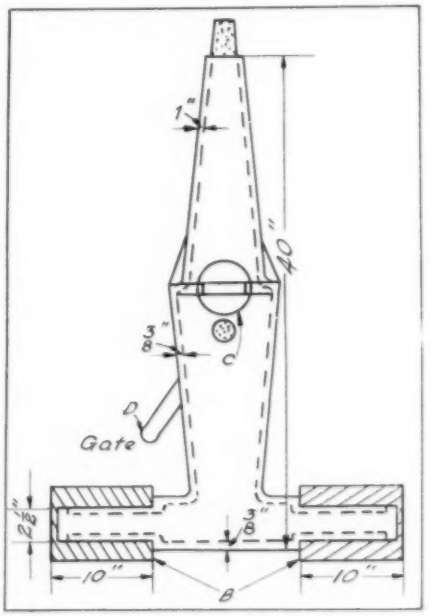


FIG. 2—CHILLS WERE USED ON THE ENDS OF THE AXLES TO ELIMINATE MACHINE WORK

Although the metal section in some parts of these castings is quite thin they were poured from basic open hearth steel in a 10-ton bottom pour ladle. The castings were shaken out shortly after they were poured and the chills immediately stripped from the ends to prevent them from growing beyond the narrow permissible limits. After they were chipped and sandblasted they were annealed and then sandblasted a second time before going into the machine shop where the part marked *F* was turned down to the required size. These chills ran from 40 to 50 heats before distortion caused them to be discarded. With proper care a surface was obtained comparing favorably with the surface on a chilled gray-iron casting. The carbon was held below 0.35 per cent. This idea is in use in the manufacture of a number of castings for various well known motor trucks.

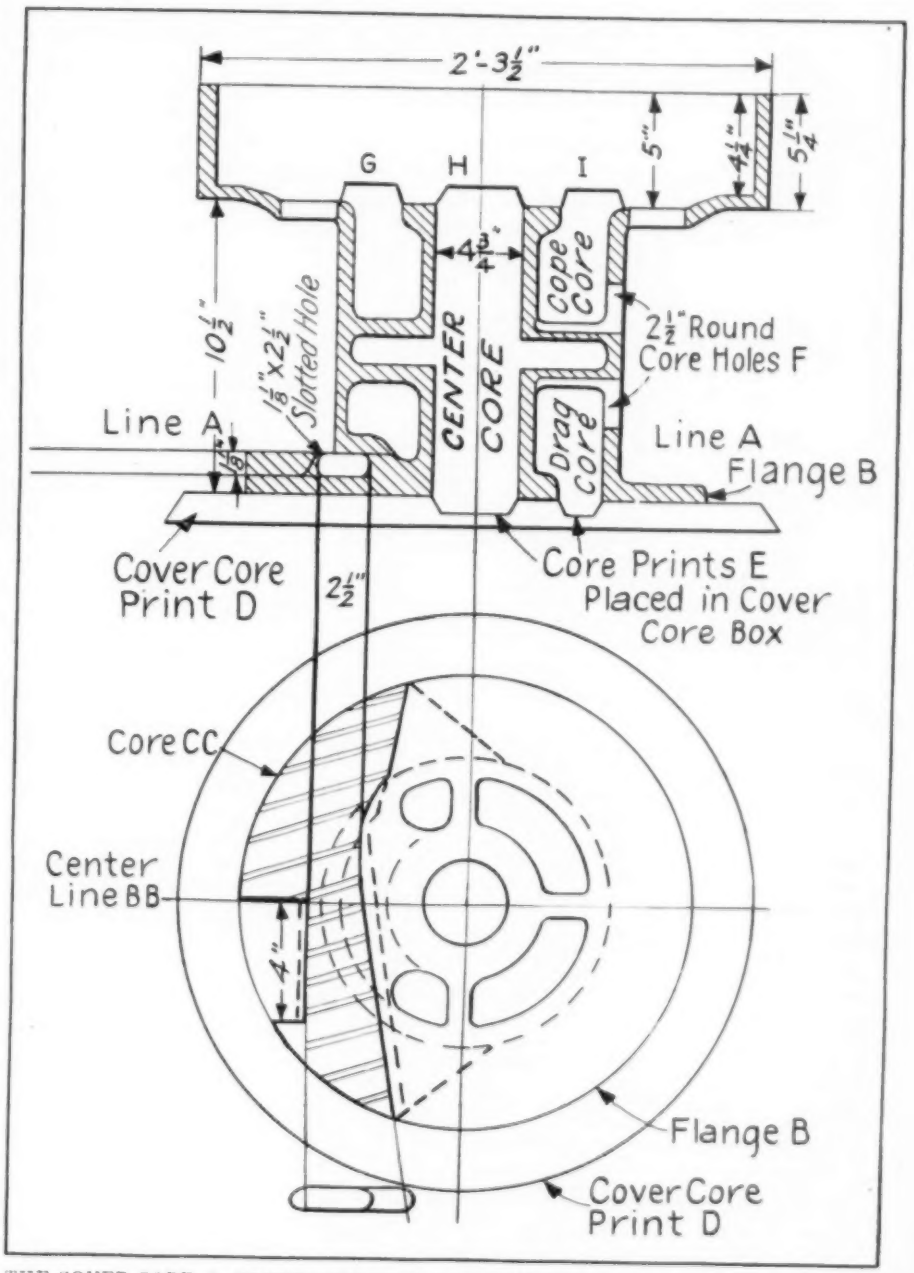
Steel Drum Made in a Two-Part Flask

BY C. J. MORETTE

WITH a view to simplifying the molding of a double-flanged, winding drum the pattern was changed as shown in the accompanying illustration. Formerly the mold was made in a 3-part flask where it was necessary to lift the cheek and cope to remove the pattern. With the present arrangement a 2-part flask is employed and it only becomes necessary to lift the cope. The pattern was built up solid to the line, *A*, then the flange, *B*, and the cover core print, *D*, were turned and dowelled to the main body of the pattern. A core print, *CC*, was attached to the flange *B*, to take care of a 1⅛ x 2½-inch slotted opening. The cover corebox is provided with core prints for locating the center core in the drag and also for locating the drag halves of the chamber cores. Similar prints are provided on the cope side of the pattern as shown at *GH* and *I*. The cope halves of the chamber core are placed in the prints *G* and *I* and attached to the cope by suitable wires before the mold is closed. The center print, *H*, serves to locate the upper end of the center core in the cope.

The pattern serves for either a right or left hand drum. The core print, *CC*, is symmetrical on both sides of the line, *BB*. As shown in the illustration, the pattern is set for a right hand drum. To make a left hand drum the loose pieces are shifted in the corebox from the right to the left hand end. The 2½-inch round cores shown at *F* are made in a separate corebox and attached to suitable prints in the drag and cope halves of the chamber cores. They are made to cut through the metal to the outside wall of the mold, as shown in the sectional view.

The pattern is placed in a drag in an inverted position to that shown in the illustration and sand is rammed around it to the top of the cover core print. The cover-core print and the flange are drawn from the mold. The core, *CC*, is set, followed by the cover core. The remainder of the drag is filled and rammed, after which the bottom plate is attached and the mold rolled over. After the cope is rammed and lifted off the remainder of the pattern is drawn and then the mold is finished, cores set and the mold closed and clamped in the usual manner and made ready for the metal. Making a pattern in this way costs a little more than the usual method, but by the time the second mold was made in the foundry, the extra cost was more than offset by the time saved in making the molds.



THE COVER CORE, *D*, CONVERTED THIS PATTERN USUALLY MOLDED IN A 3-PART FLASK INTO AN ORDINARY 2-PART JOB

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Contents

	Page
Brass Firm Makes Malleables	523
Steel Foundries Co-operate in Joint Research Work	529
Rigging for Molding Cast Iron Closet Tanks	532
Foundry Cutting and Welding	533
Promoted to Managership	536
System Rules Malleable Shop	537
Adds Cerium to Brass and Iron	542
Advance Made in Die Casting Methods	544
How and Why in Brass Founding	545
Plead to Briton's Indictments	547
Domestic Iron Meets Standards Set	547
Cites High Grade Engine Castings	548
Inexperience Blamed for Iron Quality	549
Recalls Large Cylinder Made in England	550
Pittsburgh Annual Field Day Observed	550
Opens New Spar Mine	550
Bill Discusses Pulley Molding Problems	551
Equipment Men Meet	553
Removes to New Plant	553
Study American Iron Castings	554
Book Review	554
Correcting Flaws in Metals and Mixtures	556
Composition for a Roll	556
High-Sulphur Scrap May Be Used in Mix	556
Forming Iron Balls	556
Try to Substitute Semisteel for Malleable	556
Constituents for Melting Point of Gray Iron	556
Sources of Holes in Gray-Iron Castings	556
Tips on Better Shop Practice	557
Shallow Cope Affects the Strength of Pipe	557
Pour Steel Castings in Chill Molds	558
Steel Drum Made in a Two Part Flask	559
Steel Castings Output Low	560
Attain Higher Strength Iron	560
Personal	562
Detroit Foundrymen Elect Officers	562
Offer Prizes for Pictures of Brass Objects	562
Aluminum Production Fell in 1921	562
Obituary	562
Equipment Purchases Broaden	563
What the Foundries Are Doing	564
New Trade Publications	564

Steel Castings Output Low

STEEL castings production for 1921 struck a low level unprecedented since 1908. In no other commodity was the slow pulse of industry better registered than in this branch of the foundry industry. The total output of steel castings for the past year, according to figures compiled by the American Iron & Steel Institute, was only 559,713 gross tons, which when contrasted with the previous year's production of 1,251,542 tons shows the appalling shrinkage of more than 55 per cent. Perhaps the serious aspect might better be shown by a comparison over a period of years. Computing the production for the six years including the war and the post-armistice golden era for steel castings manufacturers, the average output of all classes of steel castings was 1,219,897 tons per year, while in 1921 the total of 559,713 tons represents only about 46 per cent. No branch of the steel castings industry escaped the 1921 depression. Open-hearth steel castings dropped from a total of 986,400 tons in 1920 to 434,445 tons in 1921; bessemer castings decreased from 104,980 tons to 38,809 tons; and electric steel castings are credited with 155,196 tons in 1920 and only 85,095 tons last year. A fact worthy of note is the slight advantage in favor of the electric furnace product. The 1921 total of which is 55 per cent of the 1920 output, while in the case of open-hearth castings only 44 per cent was attained and in the bessemer class last year's manufacture was only 36.5 per cent of the previous year's.

Attain Higher Strength Iron

IN CONSIDERING the tentative standard for specifications for *high test* cast iron, or *semisteel*, adopted by the American Society for Testing Materials, calling for a tensile strength of 28,000 pounds per square inch, one naturally remembers the data on English iron submitted by F. J. Cook in his paper prepared for the American Foundrymen's association. These show a tensile strength of 28,000 to be quite common from mixtures of pig iron and scrap in England. Now the new specification admits that 28,000 pounds per square inch tensile strength is *high* for American cast iron and intimates that an admixture of steel scrap to the iron in the cupola is necessary to secure this strength in the iron commercially. Mr. Cook advances the reason for this to be the excessive speed at which pig iron is produced in this country, involving higher blast furnace temperatures. This no doubt has its effect, for as cold blast pig iron is so much stronger than hot blast iron it may naturally be concluded that intermediate temperatures have some effect even if not so marked. However, the method of handling the iron in the cupola also contributes its share. Too little is known of the reactions in this apparently simple operation and more data should be obtained to determine the best working condition for this furnace. Carbon dioxide recorders should be used to indicate the condition of the gases at different heights in the stack and the effect of iron remaining in contact with the fuel in the hearth of the cupola for some time after it is melted should be ascertained definitely. It has been shown that at this stage the iron has a tendency to pick up carbon and sulphur from the coke and the effect may be strong enough to warrant the equipment of the cupola with a forehearth allowing the iron to run from the cupola as soon as it is melted.

Trade Outlook in the Foundry Industry

WITH advancing Summer, no downward trend is apparent in the general curve of business. In fact, during the entire month of June, the contributing factors which make for industrial activity, have been exceptionally favorable. Building construction has continued at a high rate. Automobile production and sales have increased steadily. Railway purchases, although less in volume, have been more than sufficient to sustain the flow of orders to steel mills and equipment manufacturers. The foundry industry has shared in the increased activity. Practically without exception, operations in foundries were better in June than in May.

Malleables Improved

Reports from malleable foundries throughout the country indicate that in May production reached 50 per cent of capacity or almost 80 per cent of the normal output of these plants over a period of years. This remarkable record was due largely to the demand for automotive and railway castings. One foundry making both automobile and railway castings increased its production during May by 35 per cent over the preceding month. Another making jobbing castings and railway sundries noted an increase of 60 per cent in comparing the May tonnage with April's production. Further, reports indicate that the June output will excell the total for May in many of these plants, where continuous orders are received from the automobile and railway interests. The effect of purchases by the railroads during the past few months is evident all through the foundry industry. One large car wheel foundry, which built a plant for emergency service during times of exceptional demand has put this shop into operation. This foundry has been active only twice since 1907 and then only for brief periods.

Prices of Raw Material for Foundry Use

CORRECTED TO JUNE 22

Iron		Scrap	
No. 2 Foundry, Valley	$23.50	Heavy melting steel, Valley	$17.50 to 17.75
No. 2 Southern, Birmingham	19.50 to 20.00	Heavy melting steel, Pitts.	17.00 to 17.50
No. 2 Foundry, Chicago	23.00 to 24.00	Heavy melting steel, Chicago	14.50 to 15.00
No. 2 Foundry, Philadelphia	26.32 to 26.84	Stove plate, Chicago	15.75 to 16.25
No. 2 Foundry, Buffalo	26.82 to 27.26	No. 1 cast, Chicago	17.25 to 17.75
Basic, Valley	25.00	No. 1 cast, Philadelphia	19.00 to 20.00
Basic, Buffalo	24.50 to 25.00	No. 1 cast, Birmingham	13.00 to 14.00
Malleable, Chicago	23.50	No. 1 cast, Buffalo	18.00 to 18.50
Malleable, Buffalo	24.00 to 25.00	Car wheels, iron, Pittsburgh	16.50 to 17.00
Coke		Car wheels, iron, Chicago	18.25 to 18.75
Connellsville foundry, coke	$7.50 to 8.00	Railroad malleable, Chicago	16.75 to 17.25
Wise county foundry, coke	6.50 to 7.00	Agricultural mal., Chicago	16.75 to 17.25
		Railroad malleable, Buffalo	17.00 to 17.50

Car Buying Slackens

During the past few weeks, car buying has subsided, and although the inquiry continues strong and repair orders coming to foundries are exceptional, purchases of new equipment are light. However, new freight cars ordered by the railroads for the first half of 1922 are estimated at 85,000 as compared with 28,000 ordered during the twelve months of 1921. Heavier car loadings and a decrease in surplus cars continue to point to future buying. Automobile builders still play the stellar role in supplying business for the foundries of the middle western states. June is expected to set a new record in the production of passenger cars and trucks. If automobile production should continue for three years at the rate maintained during May, the number of machines in existence would be doubled, according to one observer. At present deliveries can be made only several months after the orders are received. The opinion is advanced that the demand will slacken off during the remainder of the summer and that the total production for the year will not be greatly above the average for the past few years. Gray iron specialty shops, aluminum foundries and light steel castings plants have benefitted directly from the phenomenal automotive demand.

Implement Trade Slow

Despite the excellent crop reports extant, and the announced freight rate reduction, manufacturers of farm implements do not expect a return of full prosperity before next Spring. The transportation factor will make a difference of only a few cents in the price of each piece of farm machinery. The present carrying rate on implements in one case cited is about 41 cents a hundred; the new rate will reduce this to about 37 cents; but the pre-war rate was 24½ cents a hundred. Further, the decrease in transportation costs on castings, steel and other materials entering into the construction of farm machinery will be only nominal. Pumping machinery and gasoline engine manufacturers report an improvement in orders from the rural districts and builders of farm lighting sets, washers, cream separators and similar light domestic machinery used on farms are operating at about 60 to 75 per cent of normal. Building construction shows no signs of slackening as the season advances. Consequently heating and sanitary castings are moving briskly with a marked influence upon foundry activity. The coal strike, which has assumed a menacing aspect in some directions is not as yet threatening foundry operations. Stocks of coke are practically undiminished, although some foundries are obliged to call on remote supplies. In western Pennsylvania one plant is shipping by-product coke from Indiana, paying $8 a ton at the ovens with a freight charge of about $5 additional.

Brass Shops Normal

Operations in nonferrous foundries have improved steadily under the benign influence of the same factors which have restored activity in the gray iron and malleable shops. Demand for plumbing goods has been exceptionally strong during the present season, and orders are slightly in advance of production in many instances. Eastern brass foundries report sales for export, and the requirements from machinery manufacturers have been unusually heavy. Prices on nonferrous metals, based on New York quotations in the *Daily Metal Trade* of June 22, follow: Casting copper, 13.37½c; electrolytic copper, 13.62½c; Straits tin, 31.50c; antimony, 5.12½c; lead, 5.75c; aluminum, No. 12 alloy, producers' price, 19.00c; and open market, 16.00c to 16.50c. Zinc is 5.35c, E. St. Louis.

Personal

Frank Gordon Haff has bought the half interest of Arthur A. Allard in the Southbridge Foundry Co., Southbridge, Mass., and succeeded him as treasurer of the company.

R. Branchfield, who for the past two years has been superintendent of the C. G. Bretting Mfg. Co., Ashland, Wis., has resigned to become foundry superintendent of the Witte Engine Works, Kansas City, Mo.

Adolph W. Gilbert, president and general manager of the Chapman Valve Mfg. Co., Indian Orchard, Mass., is a member of a committee appointed by Gov. Channing H. Cox of Massachusetts to confer with representatives of other New England states in developing a policy for consolidation of New England railroads.

C. F. Herington has been placed in charge of the pulverized coal department of Heyl & Patterson, Inc., Pittsburgh. This company formerly specialized in this class of work, but has been out of the field for some time. Mr. Herington has had nine years experience in designing, selling and installing pulverized coal plants for metallurigal furnaces and boilers.

E. W. Cannell has been made manager of sales extension for the Osborn Mfg. Co., Cleveland. Mr. Cannell, who has been associated with this company for more than 10 years, formerly was advertising manager and more recently was assigned to the Ohio sales territory. Guy Hamilton, who for the past two years has been engaged in other work, has been assigned to the sales department of the Osborn Mfg. Co.

John F. Schurch has been made vice president of Manning, Maxwell & Moore, Inc. and on June 1 took charge of the western sales for that company with headquarters at 27 North Jefferson St., Chicago. Mr. Schurch, since 1914 has been vice president of the T. H. Symington Co., Rochester. Previous to that time, he was connected with the Railway Materials Co., Chicago and the Minneapolis, St. Paul & Sault Ste. Marie railway.

E. J. Lowry has been retained by Hickman, Williams & Co., dealers in pig iron, coke and scrap, as service engineer, to serve their patrons in the various territories where the company operates. Mr. Lowry is to be in effect a foundry doctor, to advise foundrymen and assist in correcting difficulties met in their business. He received his education by three years attendance at Annapolis and later at Harvard and then the Massachusetts Institute of Technology, where he specialized in metallurgy. Later he was foundry foreman at the United States Arsenal at Watertown, Mass., where he gained experience in bessemer and open hearth melting, with the United States Cartridge Co., at Lowell, Mass., as metallurgist, and more recently with the Oliver Chilled Plow Co., at South Bend, Ind. While in the latter position he served as consultant and spent considerable time at the plant of the Ford Motor Co., Detroit, the Westinghouse Air Brake Co., Pittsburgh, the Walworth Mfg. Co., Kewanee, Ill., and the Studebaker Corp., South Bend.

Detroit Foundrymen Elect Officers

Fred Erb, of the Packard Motor Car Co., has been elected president of the Detroit Foundrymen's assocation. Other officers chosen for the ensuing year are: Vice president, K. C. Babo, Dodge Bros.; secretary, D. R. Hay, Murphy Iron Works; treasurer, James G. Mendenhall, Detroit Foundry Co. The following were chosen members of the executive board: S. Van Dalson, Robert Crawford, E. I. Chase, E. W. Pike, H. M. Lane, Chester Culver, manager of the employers' association, and James O'Meara.

Offer Prizes for Pictures of Brass Objects

As a part of a nation-wide campaign designed to foster the use of permanent materials in building, the Copper and Brass Research association announces a contest for school children and others, offering cash prizes for the best photographs showing the relative durability of materials which go into the construction of American homes.

Fourteen prizes ranging from $150 to $10 will be awarded for photographs of copper and brass objects of utility or ornamentation which to qualify must have been in use more than 35 years. Included are copper roofs, brass door knockers, old copper cooking utensils, brass plumbing pipe. Fourteen additional prizes of similar amounts are offered for the best photographs, showing the results of using substitutes for copper and brass.

Aluminum Production Fell in 1921

The value of the aluminum produced in the United States in 1921 was $10,906,000, compared with $41,375,000 in 1920, according to the United States geological survey.

This great decrease was due not only to a decrease in the price of the metal but to the large curtailment of its use in the automotive industries. The price quoted was steady at 28 cents a pound from January until the middle of July, when it was cut to 24.5 cents, remaining so until the first of December, when it was cut to 20 cents.

Imported aluminum could be bought throughout the year at 2 to 3 cents below the prices quoted for domestic metal of the same grade.

The imports of semimanufactured aluminum in 1921 were 32,665,300 pounds, compared with 39,298,650 in 1920. The exports of aluminum in 1921 were 2,196,100 pounds, compared with 9,407,650 in 1920.

At the Pittsburgh experiment station at the bureau of mines an investigation is being conducted with the purpose of measring the total contraction in volume on freezing, and the linear contraction in different molds, of various light aluminum alloys. This study is in connection with the investigation on cracks in castings. Measurements have been made of the linear contraction in graphite molds of a series of commercial aluminum alloys and also of the total contraction in cooling.

Obituary

Robert R. Chrisman, president, the Chrisman Foundry Co., Morgantown, W. Va., died Friday, May 15.

J. E. Davey died recently at the age of 50 years. Mr. Davey at the time of his death was works manager, Manitoba Steel Foundries, Ltd., Winnipeg, Canada.

John J. Bruce, president of the J. J. Bruce Foundry Co., died Thursday, May 18 at his home in Cincinnati. Mr. Bruce founded the business of which he was the head more than a quarter of a century ago. He had been identified with the iron and steel industry in Ohio for more than 40 years.

F. J. Town, who has been in charge of the malleable foundry of the Pittsburgh Valve & Fittings Co. for 16 years died recently at his home in Barberton, O. He went to Barberton in June, 1906, to assume full charge of the construction and supervision of the malleable foundry at the Pittsburgh Valve plant. He was head of the department until his death. Prior to joining the Pittsburg Valve company he was superintendent of the Buckeye Malleable Iron & Coupler Co., Columbus, O., for 19 years. He was born in Cleveland June 7, 1853.

Equipment Purchases Broaden

New Projects Continue Buying Movement Started in Early June—Foundry Activity Reflected in Increase in Equipment and Supply Demand—Rochester Show Brings New Business

JUNE'S early promise for more activity in foundry equipment lines has been fulfilled by the later weeks' purchases. New extensions, replacements and the stimulating influence of the equipment exhibition at Rochester all are reflected in inquiries and orders. One of the large projects announced is a new foundry to be built at the Fairfield works by the Chickasaw Shipbuilding & Car Co., Birmingham, Ala. George Gordon Crawford is president of the company. Facilities will be provided for the manufacture of ingot molds and iron castings. The United States Tractor & Machinery Co., Menasha, Wis., will build a new foundry to cost about $50,000. The Tidewater Foundries Corp., 170 First street, Jersey City, N. J. has taken a lease on the Barnes Foundry Co., Inc. plant in that city. Foreign orders are reported, notably a recent sale of a 3-ton heroult-type electric furnace by the Volta Mfg. Co., Welland, Ont. to Renton & Fisher, Ltd., Hopetown Steel Works, Bathgate, Scotland. The Ford interests in Detroit recently have purchased additional equipment. An order for 15 molding machines was received by the Berkshire Mfg. Co., Cleveland.

Increase Noted in Chicago

BUYING of foundry equipment is increasing steadily and one dealer finds June already has furnished him more business than any month in two years. Increased melt of iron is indicated by greater demand for ladles and small equipment and at the same time expectations for the future are leading many foundries to add considerably to their heavier equipment. The Cadillac Malleable Iron Co., Cadillac, Mich., expects to take off its first heat about Aug. 1, building operations having proceeded rapidly. The Maynard Electric Steel Casting Co., Milwaukee, Wis., is having plans made for an addition which will be used as a malleable foundry. A large new foundry is being projected for the vicinity of Chicago, which probably will materialize late in the fall. Interest in proper preparation of sand is indicated by buying of sand mixing machinery. The National Engineering Co., Chicago, is shipping mixers to Wheeling, W. Va., Mansfield and Cleveland, O., and Fort Wayne, Ind. Demand for cranes to complete foundry equipment is resulting in frequent sales. The Whiting Corp., Harvey, Ill., has sold a five-ton hand power to the Klander-Weldon Die & Machine Co., New York; and to the Southern Pacific railroad, San Francisco, a 20-ton crane. The same maker has sold to the Black Diamond Furnace Co., Monmouth, Ill., a 36 x 60-inch and a 24 x 48-inch tumbling barrel, to the Lycoming Motors Co., Williamsport, Pa., two A tumblers, and to Manning, Maxwell & Moore, Muskegon, Mich., a No. 5 cupola.

Extensions Contemplated in the East

A LEADING inquiry in the eastern foundry equipment market is that of the M. W. Kellogg Co., Jersey City, N. J., which is contemplating an extensive addition to its plant. Various items are enumerated, including at least five electric overhead cranes. The National Boiler Co., Garwood, N. J., also contemplating a new addition, is commencing to close on a fair sized list of equipment, recent purchases including a tumbler. One of the outstanding orders noted of late includes a large sand cutter, a large molding machine and between 600 and 700 flasks for a concern now being organized to operate a new plant in Philadelphia. The business went to a New York manufacturer. The McNab & Harlin Mfg. Co., Paterson, N. J., has recently purchased a small sand cutter and a foundry in Irvington, N. J., has bought a similar machine. Among other sales reported in the East are several booked by the Tabor Mfg. Co., Philadelphia, including the following: Two jar stripping machines, two 10-inch power squeezers, one 3-inch core jarring machine, one 10-inch plane jarring squeezer, one 10-inch shock jarring squeezer, and one power squeezing, split pattern molding machine. The Fischer-Sweeney Bronze Co., Hoboken, N. J., is expected to bring out a list of equipment, including one crane, within the next 30 days. The Phoenix Iron Works Co., Meadville, Pa., was awarded 1800 tons of cast iron tunnel lining segments for the Passaic Valley outfall pressure tunnel, but so far as can be learned no additional equipment will be required. Equipment prices continue steady.

Pittsburgh District Active

INTEREST in foundry equipment apparently is growing keener day by day. This was manifested at the American Foundrymen's association convention at Rochester where numerous sales were consummated and is shown in the numerous inquiries received by Pittsburgh sellers since their return. The general opinion appears to be that the show this year was more fruitful as regards results than any held in several years past, in that it was particularly well timed. Inquiries before the trade for foundry equipment of various characters are numerous and this is particularly true of molding machines. Sales of the latter so far this month have been heavy; recent customers of the Herman Pneumatic Machine Co., include the Ohio Steel Foundry Co., Lima, O., which closed on four large rollover machines involving one of the largest made by the Herman company. This manufacturer soon will be operating to capacity and among other sales consummated by it recently are the following: The Commercial Steel Casting Co., Marion, O., and the Lebanon Steel Foundry Co., Lebanon, Pa., one jarring machine each; the Duquesne Steel Foundry Co., Coreopolis, Pa., two jarring machines; the Scranton Pump Co., Scranton, Pa., and the Johnston & Jennings Co., Cleveland, O., one rollover machine each; and the Champion Radiator Corp., Toronto, Ont., one large rollover and one large stripping machine. Core ovens likewise have found a ready market of late. Among several to fill their core ovens' needs in the Pittsburgh market are the Sharpsburg Foundry Co., Sharpsburg, Pa., and the Pittsburgh Engineering Co., Jeannette, Pa. The Pittsburgh Lamp, Brass & Glass Co. purchased a portable core oven while the Pittsburgh Steel Foundry Co. closed on two floor type core ovens for its Glassport, Pa. plant. One Pittsburgh seller has disposed of a used brass furnace and now has a live inquiry pending for one. Current inquiries for foundry equipment include several complete installations of molding machines, some for car wheel foundries, sand mixing machines, cutting and handling

equipment as well as a 15-ton ladle and a sprue cutter. The demand from foundries for grinding machinery has improved somewhat. Cranes and hoists for foundry use still are in fair demand. The Resistant Alloy Casting Co., New Cumberland, W. Va., bought a 5-ton 3-motor electric traveling crane with 48-foot span from the Northern Engineering Works, Detroit, and the Oil Well Supply Co., Oil City, Pa., closed on a 10-ton crane with the Pawling & Harnischfeger Co. The Fairmont Mining & Machine Co., Fairmont, W. Va., closed one one each 1-ton and 2½-ton hoists with the Shepard Electric Crane & Hoist Co. which also sold one 2-ton hoist to the Marion Machine, Foundry & Supply Co., Scottdale, Pa. Several other foundries in this territory have closed upon hoists. The American Steel Foundries Co., Chicago, is understood to be considering the advisability of modernizing its present crane equipment or of buying new. It recently asked for prices on a 35-ton crane for its Alliance, O. plant. Last week the Westinghouse Electric & Mfg. Co. closed on a 5-ton, 3-motor 47-foot span crane and a 10-ton 3-motor 47 foot 0-inch span crane with the Milwaukee Electric Crane & Mfg. Co.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

The plant of the Heroz Iron Works, Minneapolis, recent was damaged by fire.

The plant of the Anchor Brass & Aluminum Co., Cincinnati, recently was damaged by fire.

Operations have been resumed at the plant of the Zanesville Malleable Co., Zanesville, O.

The plant of the Pittsburgh Malleable Iron Co., Pittsburgh, recently was damaged by fire.

Erection of a factory building, 1-story, 40 x 60 feet, is planned by the City Iron Works, 444 West Thirty-eighth street, New York.

Erection of a plant building, 1-story, 76 x 138 feet, is planned by the Western Foundry Co., 3634 South Kedzie avenue, Chicago.

Capitalized at $14,000 the Bloomsburg Locomotive Works, Bloomsburg, Pa., recently was incorporated by W. R. Kocher and others.

The foundry at the plant of the National Sanitary Co., Salem, O., recently was damaged by fire.

Five buildings owned and occupied by the Meeker's Union Foundry Corp., Norwalk, Conn., recently were damaged by fire.

The plant of the Sandusky Foundry & Machine Co., Sandusky, O., recently was damaged by fire.

Capitalized at $5000 the Underwood Furnace Co., Dayton, O., recently was incorporated by C. P. Folsom, A. V. Howell and others.

Erection of a 1-story foundry building is understood to be under consideration by the National Pump & Machine Co., Oil City, Pa.

Erection of an addition to its plant is being planned by the Frank Foundry Co., Davenport, Iowa.

The Gulf Welding & Machine Works, Beaumont, Tex., plans the erection of a foundry and machine shop.

The M. W. Kellogg Co., Jersey City, N. J., is having plans prepared for the erection of an addition to its plant.

Plans are being prepared for the erection of a foundry building by the National Boiler Co., Garwood, N. J.

The Arkansas Foundry Co., Little Rock, Ark., has let a contract for the erection of a plant building to cost about $20,000.

Hillis & Sons, Ltd., Halifax, N. S., iron founders and machinists, are rebuilding their plant which was wrecked by an explosion in 1917.

Erection of a plant on a site, 129 x 140 feet at Little Rock, Ark., is reported under consideration by the Nelson Mfg. Co., manufacturer of furnaces, etc.

Bids will be taken shortly for the construction of a foundry for the United States Tractor & Machinery Co., Menasha, Wis., which plans to produce practically all its own casting supply for tractor manufacture and a line of power farm implements it is now producing. The foundry will be 50 x 200 feet.

Erection of a foundry building, 40 x 80 feet, is planned by the Hartford Foundry Co., Hartford City, Ind. Plans have not been completed as yet.

The Chicago Hardware Foundry Co., North Chicago, Ill., is having plans prepared for the erection of an addition to its plant, to be 1-story 60 x 100 feet, and cost about $50,000.

The Temple Furnace Co., Temple, Pa., recently was incorporated with capital stock by F. E. Werner, the Touraine, Philadelphia, and others.

A site has been purchased at Hibbing, Minn., by the Munising Foundry Co., Munising, Mich., on which it is reported planning the erection of a foundry building.

The Sullivan Machinery Co., 122 South Michigan avenue, Chicago, is having plans prepared for the erection of a plant at Michigan City, Ind. Contracts have not been let.

The Acme Works, Inc., Indianapolis, manufacturer of castings, etc., is having plans prepared for the erection of a 1-story addition to its plant.

The Star Mfg. Co., Providence, R. I., maker of malleable iron unions, will be sold to settle the estate of Emory Smith, who for many years was the sole owner. Arthur Hening is administrator of the estate.

A company is being formed at Gloucester City, N. J., by A. W. Grant, Harrison building, Philadelphia, to engage in the manufacture of engines, etc. The company plans to erect a plant building, 1-story, 100 x 500 feet.

A. B. Day, Knoxville, Tenn., has purchased the plant of the State Mine Car & Foundry Co., Huntington, W. Va., and will organize a company to be known as the Cumberland Iron Co.

The Ironide Foundry, Inc., plans to establish a plant at Ware, Mass. The company has been incorporated with a capital stock of $50,000 and will remodel a former power house building, which it will occupy.

Capitalized at $100,000 the Ohio Refractories Co., Portsmouth, O., recently was incorporated by M. K. Hitchcock, H. W. Heer, Norman Adams, B. H. Dillon, James A. Hager, George D. Selby and others.

Erection of an addition to its foundry is planned by the Arcade Malleable Iron Co., Worcester, Mass. Plans call for a building, 1-story, 54 x 86 feet. The general contract has been let.

Arthur Murphy of Paterson, N. J., and Thomas and Mary E. Baerdmore, have been named as the incorporators of the Niagara Falls Smelting & Refining Co., which was recently incorporated in Delaware. The company is represented by the Corporation Service Co.

The Roberts & Mander Stove Co., Eleventh and Washington streets, Philadelphia, is reported having plans prepared for the erection of a plant at Hatboro, Pa.

Heavy demand for railroad car wheels has caused the Griffin Wheel Co., Chicago, to place in operation its foundry, in connection with the Sacramento Square plant in Chicago. The foundry is operated only when heavy demand requires and has been active only twice since 1907 and then for brief periods. For the past four years it has been idle. Addition of this foundry places the Griffin Wheel Co's. plants at capacity, the demand being for wheels for repair as well as for new cars.

New Trade Publications

FOUNDRY FLASKS.—A 32-page illustrated booklet has been published by the Truscon Steel Co., Youngstown, O., in which testimonial letters from users of foundry flasks manufactured by the company, are reproduced. A partial list of users is given.

RHEOSTAT—The Allen-Bradley Co., Milwaukee, has published a 4-page illustrated folder in which a rheostat for general laboratory use is described. This rheostat has a normal capacity of 200 watts but will stand 500 to 1000 under momentary loads. It has a resistance range in the ratio of 100 to 1 for the whole column of disks. The use of a smooth glass material for insulating the disks from the support rod reduces friction to a minimum. It will carry a maximum of 40 amperes continuously and is suitable for use on either alternating or direct current circuits up to 250 volts. It is portable and may be used in either a vertical or horizontal position, or attached underneath a bench in an inverted position.

ANNEALING OVENS—An attractive catalog of 33 pages has been issued by the Paul Maehler Co., 2210 West Lake street, Chicago, manufacturer of annealing ovens, core ovens and various other oven units, and burner equipment. It covers the construction, ventilation and circulation, assembling of ovens, the various fuels for industrial ovens and a special chapter on conveyor and special type ovens. It is adequately illustrated by line drawings and half tones, detailing construction, assembling and operation, with presentments of various installations now in use. Specifications of various types of ovens are also furnished. This catalog contains much information for oven users and covers the subject fully.